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(54) LED ARRANGEMENT FOR EMITTING WHITE LIGHT OF A DESIRED COLOR TEMPERATURE AND LIGHTING SYSTEM COMPRISING SUCH AN LED ARRANGEMENT

(57) The invention regards LED arrangement in the lighting system using such an LED arrangement for emitting white light of a desired color temperature between a first color temperature and a second color temperature. The lighting system comprises at least a first group of white light LEDs emitting white light with the first color temperature and a second group of white light LEDs emitting white light with the second color temperature, the arrangement being configured to receive individual drive signals for the first group of white light LEDs and the second group of white light LEDs. At least the LEDs of the first group of white light LEDs or the LEDs of the second group of white light LEDs are classified into a first class and a second class with a chromaticity emitted by the LEDs in the first class and a chromaticity emitted by the LEDs in the second class lying on opposite sides of a separation line extending in parallel to a Planckian locus, wherein the LED arrangement is configured to receive individual drive signals for the first class of LEDs and the second class of LEDs.

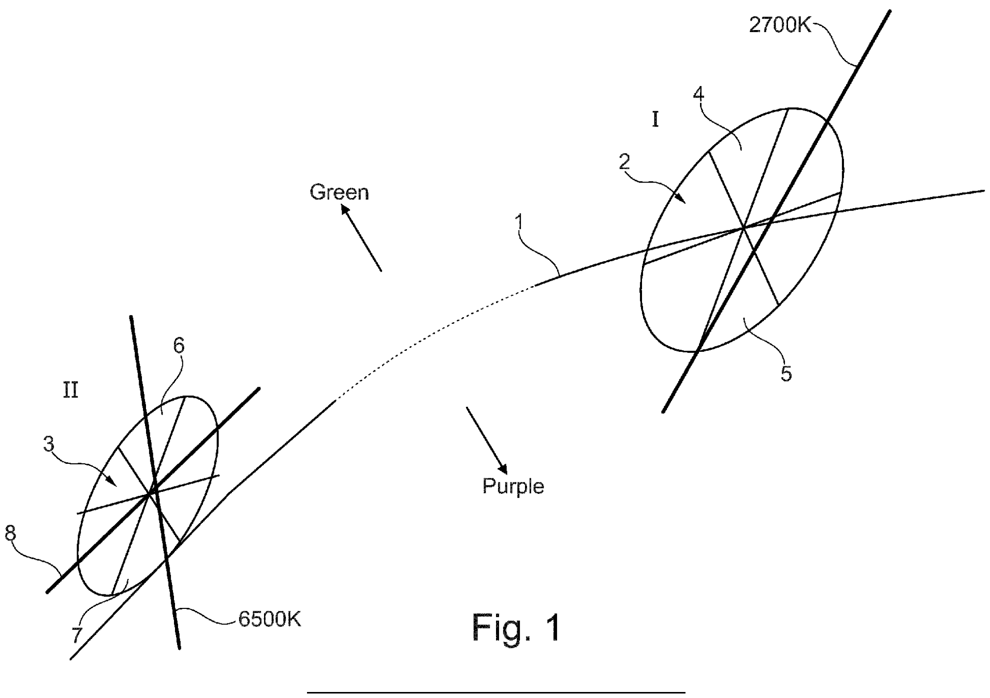

Fig. 1

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Description

[0001] The present invention is in the technical field of adjusting a color temperature of white light using a plurality of white light LEDs emitting white light at different color temperatures and allowing to calibrate color drift. Specifically, the invention regards a LED arrangement for emitting white light of a desired color temperature by mixing light emitted by LEDs producing white light with a first color temperature and light emitted by LEDs producing white light with a second color temperature. The invention further regards a lighting system comprising such a LED arrangement and at least one drive unit for driving the LEDs accordingly.

[0002] In many situations it is desirable to be able to adjust the color temperature of white light to the specific needs of a situation or, more general, an application of a lighting device such as a luminaire. A variety of approaches have been developed, using LEDs that produce white light at different color temperatures. In a system using LEDs emitting light at a first color temperature and LEDs emitting light at a second color temperature it is possible to adjust the color temperature of the white light emitted in combination between the first color temperature and the second color temperature. This may be achieved, for example, by driving the LEDs emitting light with the first color temperature and the LEDs emitting the light with the second color temperature individually. PWM may be used in order to set the resulting color temperature by adapting the duty cycles for the LEDs emitting light with the first color temperature and LEDs emitting light with the second color temperature thereby adjusting the relative intensities.

[0003] Such a proposal has been made for example in WO 2014/177535 A1. Generally, such a solution is based on the assumption that the color emitted by the LEDs emitting light with the first color temperature and the color of the LEDs emitting light with the second color temperature emits light having distinct spectra. Then, the chromaticity result from a mixture of light from both groups of LEDs lies on a straight line between the chromaticity of the first group and the chromaticity of the second group. The exact position is defined by the relative intensities of the light emitted with the first temperature and the light emitted with the second temperature. However, the color tolerance of an LED is two-dimensional and correcting the resulting color in a direction orthogonal to that straight line might become necessary. Above-mentioned international patent application already gives a hint that additional LEDs emitting green light and emitting purple light could be used to perform, with respect to the straight line, a vertical correction of the color value of the finally emitted mixture of light.

[0004] LED-modules, luminaires or, generally LED arrangements that allow illuminating a room or an outside area are mass products and production costs must therefore be kept low. It is evident that using two distinct additional LEDs having different colors, which do not contribute to the production of white light, must increase the cost for the production. Thus, there is a need to find an alternative solution allowing to adjust the chromaticity coordinates of the emitted white light and respective color value two-dimensional.

[0005] This object is achieved by the LED arrangement and lighting system according to the present invention.

[0006] The present invention provides an LED arrangement for emitting white light of a desired color temperature as a mixture of emitted white light at a first color temperature and white light at a second color temperature. The white light at a first color temperature is produced by a first group of white light LEDs emitting white light at the first color temperature and the white light at a second color temperature is produced by a second group of white light LEDs emitting white light at the second color temperature. For adjusting the overall color temperature to match the desired color temperature when mixing light emitted by the first group of LEDs and light emitted by the second group of LEDs, the LEDs of the first group and the LEDs of the second group can be driven independent from each other. This means that the current supplied to the LEDs of the first group can be adjusted independent from the current supplied to the LEDs of the second group. Thus, the intensity of the light emitted by the LEDs of the first group can be adjusted relative to the intensity of emitted light produced by the LEDs of second group. According to the relative intensities of light at the first on the temperature and light at the second color temperature, the mixed light is white light at a color temperature between the first color temperature and the second color temperature.

[0007] According to the invention, at least the LEDs of the first group of white light LEDs or the LEDs of the second group of white light LEDs are classified into a first class and a second class. The light color emitted by the LEDs in the first class and the light color emitted by the LEDs in the second class lies on opposite sides of a separation line extending in approximately parallel to a Planckian locus. In other words, the LEDs in the first class and the LEDs in the second class belonging to the same group of LEDs (meaning that they produce white light of the same color temperature) have different chromaticity coordinates and a line connecting these chromaticity coordinates (for example the average within each class) has at least an orthogonal component with respect to the Planckian locus. The LED arrangement is further configured to receive individual drive signals for the first class of LEDs and the second class of LEDs. Adjusting the relative intensity of emitted white light by the first class LEDs and the second-class LEDs results in the same effect as using an additional green LED and an additional purple LED: instead of only being able to adjust the color temperature along a straight line (one-dimensional) it is now possible to adjust two-dimensional.

[0008] It is to be noted that this is achieved without any additional costs. It is already known in the art to classify LEDs of the same color temperature at the end of their production process, for example, using six bins for each type of LEDs intended for emitting white light of a certain color temperature. This process is also known as "kitting". Usually, in the production of an LED arrangement such as an LED-module, LEDs taken from two bins diametrical to the center point of the distribution of LEDs of the same type are arranged in a distributed manner so that the mixture of emitted light off the LEDs of the two bins is as close as possible to the center of this distribution.

[0009] The invention now also exploits that the LEDs are sorted and that LEDs of such bins are commercially available, but avoids mixture of these LEDs belonging to different bins or classes. Rather, the classes of LEDs are arranged in the LED arrangement in such a way that LEDs belonging to the first class (or bin) are commonly driven and LEDs belonging to the second class (or bin) are commonly driven, but the two classes are driven independently from each other. Thus, the intensity of light emitted by the LEDs belonging to the first class can be adjusted relative to the intensity of light emitted by the LEDs belonging to the second class. Since the classes are defined such that the chromaticity of the LEDs belonging to the different classes of the same group of LEDs have a distance in the green-purple direction, this allows to adjust the finally emitted light with respect to the second dimension without the need of adding LEDs having a dedicated green and purple color. The color rendering index (CRI) of green LEDs and CRI of purple LEDs are rather poor. To the contrary, white LEDs generally outperform in terms of CRI. Thus, avoiding green and red LEDs but maintaining the possibility to adjust the chromaticity improves the CRI.

[0010] This effect is achieved by a lighting system comprising an LED arrangement as described above and comprising at least one drive unit configured to individually drive the first group of white light LEDs and the second group of white light LEDs such that the mixture of the emitted first color temperature white light and the emitted second color temperature white light results in white light with the desired color temperature. Then, the at least one drive unit drives the first class LEDs and the second class LEDs individually, which allows to adjust the color of the emitted white light of the desired color temperature in a direction having an orthogonal component with respect to the direction of color temperature adjustment.

[0011] Further, advantageous aspects and features are defined in the dependent claims.

[0012] It is particularly preferred that both, the LEDs of the first group and the LEDs of the second group each are classified into respective first classes and second classes. Classifying not only the LEDs of one of the groups but additionally also the LEDs of the second group extends the two-dimensional region in which an adjustment and correction (calibration) of the color temperature and the color value is possible. The area is basically a rectangle in the CIE diagram. It is further preferred that the number of LEDs in the first group and the number of LEDs in the second group does not differ to much from each other in order to allow adjustment of the color value with both ends of the range of the color temperature emitting light having similar brightness. Although it is desirable to have an identical number of LEDs of the first group and LEDs of the second group, the concrete implementation may only allow to have a different number of LEDs, which, preferably, is less than 10%, more preferable less than 5%. The same consideration is true for the number of LEDs in the first class and the number of LEDs in the second class belonging to the same group.

[0013] It is to be noted that the desired effect may well be achieved when only two groups of white light emitting LEDs are used. However, it is also possible to increase the number of groups to 3 or increase the number of groups to more than 3.

[0014] It is particularly preferred that the LED arrangement comprises a plurality of groups and each group comprises the first class and the second class of LEDs, respectively. Thus, in each group of LEDs, which correspond to a certain color temperature, the different groups having different color temperatures, the LEDs are classified into two classes. At least the first classes belonging to different groups are arranged in an interleaved manner, and second classes belonging to different groups are arranged in an interleaved manner, preferably such that an even distribution is achieved. Such an even distribution may be achieved for example combining one LED of each class of each group to form a set of LEDs, and arranging a plurality of such sets in a regular pattern. Combining one LED of each class of each group into a set of LEDs bears the advantage that heat produced during operation is evenly distributed and no hotspots might lead to an early failure of the LED arrangement.

[0015] Multichannel drivers are commercially available. Thus, it is preferred to use such commercially available multichannel drivers in order to drive the LEDs belonging to the first class and the second class of the same group or belonging to the first classes of the first and second group, respectively. In case that two groups are used, each being classified in the first class and in the second class, one might think of using two two-channel drivers. Alternatively, a single four-channel driver could be used. In principle, it is also possible to use single channel drivers. In any case, the drivers may be controlled by an external control signal such that in response to the external control signal the drivers supply via the dedicated channels the respectively driven class of LEDs with the necessary voltage and current to produce light with a desired intensity relative to the intensities of the other LEDs connected to other channels. The relative portion for achieving a desired color temperature with the chromaticity coordinates within the adjusted range can be set in advance defining the output for each drive channel.

[0016] In essence, the at least one drive unit is configured to control the channels such that the relation of combined light intensity of the LEDs of the first group and the combined light intensity of the LEDs of the second group adjust the color temperature of the emitted white light of the lighting system to the desired color temperature. For additionally adjusting the chromaticity in an orthogonal direction, the at least one drive unit is additionally configured to control the channels driving the LEDs of the first class and the LEDs of the second class of the same group such that the combined light intensity of the LEDs of the first class and the LEDs of the second class fulfil the relation according to the desired chromaticity coordinates.

[0017] Advantageous embodiments and further aspects of the present invention will now be described with reference to the annexed drawings in which

figure 1 is an illustration of the concept underlying the present invention;

figure 2 shows a CIE 1931 - diagram for the principle of adjusting a chromaticity in a two-dimensional area;

figure 3 shows an enlarged section III of figure 2;

figure 4 shows the spectra of white light emitting LEDs belonging to different classes of different groups according to the invention;

figure 5 shows resulting spectral distributions for the LED combinations of the corners of figure 3;

figure 6 shows one example of an interleaved arrangement of classes of different groups in an implementation using two-channel systems; and

figure 7 shows a further example with an even distribution using a single four-channel driver.

[0018] Before implementations of the inventive LED arrangement and respective lighting system using such an LED arrangement are explained in more detail, the principle underlying the present invention shall briefly be explained.

[0019] Figure 1 shows excerpts taken from a CIE 1931 diagram with the Planckian locus 1. Two sections of the Planckian locus 1 are shown as solid lines. The two sections shown as solid lines are connected by a dashed section, because the illustration of the different regions of the CIE 1931 diagram is not to scale. On the right side of figure 1, there is an area denoted with reference 2 around a center defining an ideal chromaticity in the CIE 1931 diagram for a first group of LEDs assumed that the LEDs have no color tolerance. The first group of LEDs are a plurality of LEDs emitting white light at a first color temperature, for example 2700 K. As it can be seen in the illustration, the ideal color value in the CIE 1931 diagram lies directly on the Planckian locus 1, very close to the intersection with the 2700 K line.Even though all LEDs of the same group should ideally emit white light having identical spectra, a color tolerance of LEDs, which is a two-dimensional distribution around the center point, cannot be avoided. Therefore, manufacturers of LEDs classify their LEDs, which means that LEDs having similar spectra were collected into one bin. Classifying the LEDs means that LEDs are sorted with respect to the chromaticity of their emitted light so that they can be associated, in the illustrated example to one of six areas that are evenly distributed around the center point of the ideal chromaticity and indicated by six sectors. It is to be noted that the number of bins and the size of the sectors is not limiting and chosen only for illustration purposes as shown in the drawing.

[0020] In order to emit light as close as possible to the ideal chromaticity (the center point), LEDs belonging to classes located diametrical to the center point are mixed and commonly driven. This approach is used in conventional systems by mixing for example LEDs of a first class 4 and LEDs of a second class 5.

[0021] According to the invention, the LED arrangement also uses the LEDs belonging to the first class 4 and the LEDs belonging to the second class 5, wherein the classes are generated by sorting a larger number of LEDs, all of same type forming the first group of LEDs emitting white light with the first color temperature. However, the LEDs of the first class 4 and the second class 5 of the first group of LEDs are not commonly driven but individually so that the chromaticity of the light emitted by the entirety of LEDs of the first class 4 and the second class 5 can be shifted to a position in the CIE 1931 diagram in a direction approximately orthogonal to the Planckian locus 1.

[0022] The second group of LEDs emitting white light of a second color temperature, for example 6500 K, will, due to the color tolerance of the LEDs, be distributed around a second center in the middle of the area denoted by reference 3. Again, the plurality of LEDs of the second group of LEDs emitting white light at the second color temperature is classified into a first-class 6 and a second class 7. Generally, the entirety of LEDs belonging to the second group are sorted into six bins, again. The six bins are indicated as six sectors in the drawing. Since the LEDs belonging to a particular group are commercially available already sorted (classified), the respective classes 6, 7 of LEDs having chromaticity diametrical to the center point of the second group of LEDs are selected. It is preferred that the selected classes 6, 7 are selected such that the LEDs of the first class 6 emit light with a chromaticity lying on one side of line 8 and the LEDs of the second class 7 emit light with a chromaticity lying on the other side of line 8. The line 8 extends approximately in parallel to the Planckian locus 1 in the area of LEDs of the second group. In case that the center of a group of LEDs lies directly on the Planckian locus 1, the line 8 may coincide with the Planckian locus 1. This is for example the case for the first group of LEDs as depicted in region I.

[0023] It is noted, that the first group of LEDs and/or the second group of LED may include LEDs of the first class including LEDs that have been classified (sorted) into plural classes. Additionally or alternatively, the first group of LEDs and/or the second group of LED may include LEDs of the second class including LEDs that have been classified (sorted) into plural classes, for example, one or more classes different from class 7.

[0024] This illustrates that the number of bins and the size of the sectors is not limiting and chosen only for illustration purposes in the drawing. The classes 4, 5, 6, 7 in fig. 1 may correspond to bins of preselected LEDs provided by a supplier. In this example, one may use a mixture of LEDs from different classes (bins or sectors) as the first class of LEDs with a chromaticity lying on one side of the separation line 8. Alternatively or additionally, a mixture of LEDs from different classes (bins or sectors) LEDs from different classes (bins or sectors) may be used as the second class of LEDs. This applies as long as the requirement that the LEDs of the second class have a chromaticity of the emitted light lying on the other side of the separation line 8 with respect to the LEDs of the first class is fulfilled. It is to be noted that the expression "area of an LED" or the like is a brief description of "an area of chromaticity in the CIE 1931 diagram emitted by the LEDs". Similar considerations are valid for single LEDs and, obviously, for the LEDs of the first group.

[0025] For the present invention it is important that at least one group of LEDs is classified into two classes such that the LEDs of these two classes correspond to areas in the CIE 1931 diagram that have a distance from each other and a connecting line of these areas comprises at least an orthogonal component with respect to the Planckian locus 1. The distance of the areas maybe calculated based on respective reference points of the areas. The reference points of the areas of the first class and the second class can be calculated as an average value of the chromaticity of all LEDs belonging to this respective class. When the reference points of the two classes of the same group of LEDs are on opposite sides of the line 8 extending parallel to the Planckian locus 1, there are LEDs in the group that emit light more towards green on the one hand and, on the other hand there are LEDs in this group that emit light with a higher fraction of purple.

[0026] In addition to finding a color temperature on a line between the center point of the LEDs of the first group and the LEDs of the second group, it is now also possible to adjust the chromaticity in a direction orthogonal to the line between the center points of the LEDs of the first group and the LEDs of the second group. Thus, with the present invention it is possible to compensate for two-dimensional tolerances of the white light LEDs and calibrate color drift.

[0027] In order to emit light of the desired color temperature, it is necessary to adjust the relative intensity of the light emitted by the LEDs of the first group in the LEDs of the second group. Such an adjustment may, for example, be done by setting duty cycles for the LEDs of the first group and for the LEDs of the second group, accordingly. Once the duty cycles for the LEDs of the first group and the LEDs of the second group are set, a position on the connecting line between the center point of the first group of LEDs and the center point of the second group of LEDs is found. Then, a correction in a direction orthogonal to that connecting line can be performed. The intensity of light emitted by the LEDs of the first class of the first group and of the light emitted by the LEDs of the second class of the first group is now adjusted relative to each other such that the overall emission of intensity of light at the first color temperature (in the example 2700 K) by both classes of the first group of LEDs is kept stable with the intensity of light emitted by the LEDs of the second group. The same is done for the first class of LEDs of the second group and second class of LEDs of the second group. The latter adjustment of the relative intensity of emitted light of the classes belonging to the same group of LEDs allows a lateral correction of the color value.

[0028] Figure 2 shows a CIE 1931 diagram in which the first area I and the second area II corresponding to the LEDs of the first group emitting white light at the color temperature of 2700 K and the second group emitting white light at the color temperature of 6500 K are shown with the third area III therebetween, which can be seen in an enlarged view in figure 3.

[0029] In figure 3, a two-dimensional area is shown which is almost of rectangular shape. This area corresponds to the two-dimensional area in which the chromaticity coordinates can be adjusted using LEDs of the first group and LEDs of the second group, the LEDs of each group being classified into a first-class and a second class as explained above. The corners of the two-dimensional area are defined by the position of the classes in the CIE 1931 diagram and represent measurement points of pairs of LEDs a+e, a+b, d+e, and b+d. The spectra of these LEDs are shown in figure 4. Choosing the classes on opposite sides of the Planckian locus 1 (or on opposite sides of a parallel line 8 in case that the center of the respective LED group does not lie on the Planckian locus 1) maximizes the area in which the chromaticity can be adjusted in a direction orthogonal to the bold line 10 in figure 3, corresponding to a connecting line of the center points of the first group LEDs & the second group LEDs. Without the present invention, the resulting chromaticity point would simply lie on the line 10, maybe with a vertical offset that cannot be compensated because mixing and commonly driving the mixed LEDs of diametrical classes of the same color temperature only allows one dimensional adjustment between the center point of the LEDs of the first group and the center point of the LEDs of the second group.

[0030] Figure 4 shows spectra of LEDs of the first class and the second class of the first group and also of the LEDs of the first class and the second class of the second group. The LEDs of the first and second class of the first group (2700K) are denoted with "a" and "d", and the LEDs of the first and second class of the second group (6500K) are denoted with "b" and "e".

[0031] Figure 5 shows the spectral distributions for pairs of LEDs pairs of LEDs a+e, a+b, d+e and b+d that define the corners of the almost rectangular area explained with reference to figure 3. It can be seen that the spectral distributions vary and the chromaticity can thus be adjusted by operating the LEDs of the four classes in combination.

[0032] Figure 6 shows one example of an arrangement of LEDs according to the present invention. Starting from the explanations above, the first group of LEDs emitting light with 2700 K and the second group of LEDs emitting light with 6500 K is used. Both groups of LEDs are classified, in the present example into classes denoted with "a" and "d" for the first group of LEDs and "b" and "e" for the second group of LEDs. The four classes of LEDs are distributed on two modules 11 and 12, which are usually used for commonly known tunable white systems. Accordingly, each module 11 and 12 comprises a two-channel driver 13 and 14, which, in the present embodiment of the invention, are commonly operated to drive the LEDs of all 4 classes.

[0033] As it can be seen in figure 6, on the first module 11, LEDs of the second class of the first group (d) are arranged in an interleaved manner with LEDs of the second class (e) of the second group of LEDs. In a similar way, on the other module 12, LEDs of the first class of the first group (a) are arranged in an interleaved manner with LEDs of the first class of the second group (b). In the present case, two two-channel drive units 13 and 14 are used so that for the LEDs of each class a dedicated channel of one of the drive units is available. This allows to adjust the average current through the LEDs of a particular class independently from the average current through the LEDs of another class. Thus, the relative intensity can be adjusted between the light emitted by the LEDs of the first group and the light emitted by the LEDs of the second group but additionally between the first class LEDs and the second class LEDs of the same group. This ability to adjust individually the current through the LEDs of each class of each group spans the rectangular, two-dimensional area as explained with reference to figure 3.

[0034] It is further shown in figure 6 that each of the modules 11, 12 comprises a power connector 15 and 16, respectively for supplying the respective drive unit 13, 14 with electric power.

[0035] The shown arrangement of LEDs in an interleaved manner according to figure 6 is only one possibility. There are other arrangements like, for example, the pattern as shown in figure 7. Again, the LEDs belonging to the two groups having different color temperatures of the emitted light are classified into a first class and a second class, respectively. In figure 7 the regular pattern is formed from a plurality of sets of LEDs. Each set of LEDs 20 comprises a single LED of each class. Such an even distribution of the entirety of LEDs involved in producing white light at a desired color temperature improves heat dissipation and avoids hotspots that might lead to early failure of the system.

[0036] In addition to showing another example for an arrangement of the different LEDs, figure 7 also shows that a single four-channel drive unit 21 can be used so that each channel of the multichannel drive unit 21 is dedicated to first or second class LEDs of the first or second group of LEDs.

[0037] In case that the plurality of drive units is operated in a cooperative manner, it must be ensured that the drive units are commonly controlled. This might be achieved by using dimming signals so that with the central processor the relative intensity of the emitted light by the entities driven by a particular channel can be adjusted.

[0038] It is to be noted that the LED arrangement according to the above illustrated embodiments is not limited to any specific shape of the LED-module with the LED arrangement. For example, the arrangement maybe realized in a module having rectangular shape, round shape, stripe shape or is implemented as a flex tape.

Claims

1. LED arrangement for emitting white light of a desired color temperature between a first color temperature and a second color temperature, the lighting system comprising at least a first group of white light LEDs (a, d) emitting white light with the first color temperature and a second group of white light LEDs (b, e) emitting white light with the second color temperature, the arrangement being configured to receive individual drive signals for the first group of white light LEDs (a, d) and the second group of white light LEDs (b, e),
characterised in that
at least the LEDs of the first group of white light LEDs (a, d) or the LEDs of the second group of white light LEDs (b, d) are classified into a first class (4, 6) and a second class (5, 7) with a chromaticity emitted by the LEDs in the first class (4, 6) and a chromaticity emitted by the LEDs in the second class (5, 7) lying on opposite sides of a separation line (8) extending in parallel to a Planckian Locus, wherein the LED arrangement is configured to receive individual drive signals for the first class of LEDs (4, 6) and the second class of LEDs (5, 7).

2. LED arrangement according to claim 1,
characterized in that
both, the LEDs of the first group (a, d) and the LEDs of the second group (b, e) each are classified into respective first classes (4, 6) and second classes (5, 7).

3. LED arrangement according to claim 2, **characterized in that** the number of LEDs in the first group (a, d) and the number of LEDs in the second group (b, e) differ less than 10%, preferably less than 5%.

4. Lighting system according to any one of the preceding claims, **characterized in that** the number of LEDs in the first class (4, 6) and the number of LEDs in the corresponding second class (5, 7) differ less than 10%, preferably less than 5%.

5. LED arrangement according to any one of the preceding claims, **characterized in that** the LEDs of each group (a, d, b, e) are classified into respective first classes (4, 6) and second classes (5, 7) and the LEDs of the first classes (4, 6) of at least two groups are arranged in an interleaved manner and the LEDs of the second classes (5, 7) of the at least two groups are arranged in an interleaved manner.

6. Lighting system comprising an LED arrangement according to any of the preceding claims, **characterized in that** the system comprises at least one drive unit (13, 14, 21) configured to individually drive the first group of white LEDs (a, d) and the second group of white light LEDs (b, e) such that the sum of the emitted first color temperature white light and the emitted second color temperature white light results in white light with the desired color temperature and to drive the first class (4, 6) and the second class of LEDs (5, 7) individually to adjust a chromaticity of the emitted white light of the desired color temperature in a direction having an orthogonal component with respect to the direction of color temperature adjustment.

7. Lighting system according to claim 6, **characterized in that** the at least one drive unit (13, 14, 21) comprises a plurality of channels for driving the LEDs of the lighting system, wherein the LEDs of each class (4, 6, 5, 7) are driven by a dedicated channel of the plurality of channels.

8. Lighting system according to claim 7, **characterized in that** that the at least one drive unit (13, 14, 21) is configured to control the channels such that a relation of a combined light intensity of the LEDs of the first group (a, d) and a combined light intensity of the LEDs of the second group (b, e) adjusts the color temperature of the emitted white light of the lighting system to the desired color temperature.

9. Lighting system according to claim 8, **characterized in that** the at least one drive unit (13, 14, 21) is configured to control the channels driving the LEDs of the first class (4, 6) and the LEDs of the second class (5, 7) of the same group such that the combined light intensity of the LEDs of the first class (4, 6) and the LEDs of the second class (5, 7) fulfil a relation according to a desired chromaticity.

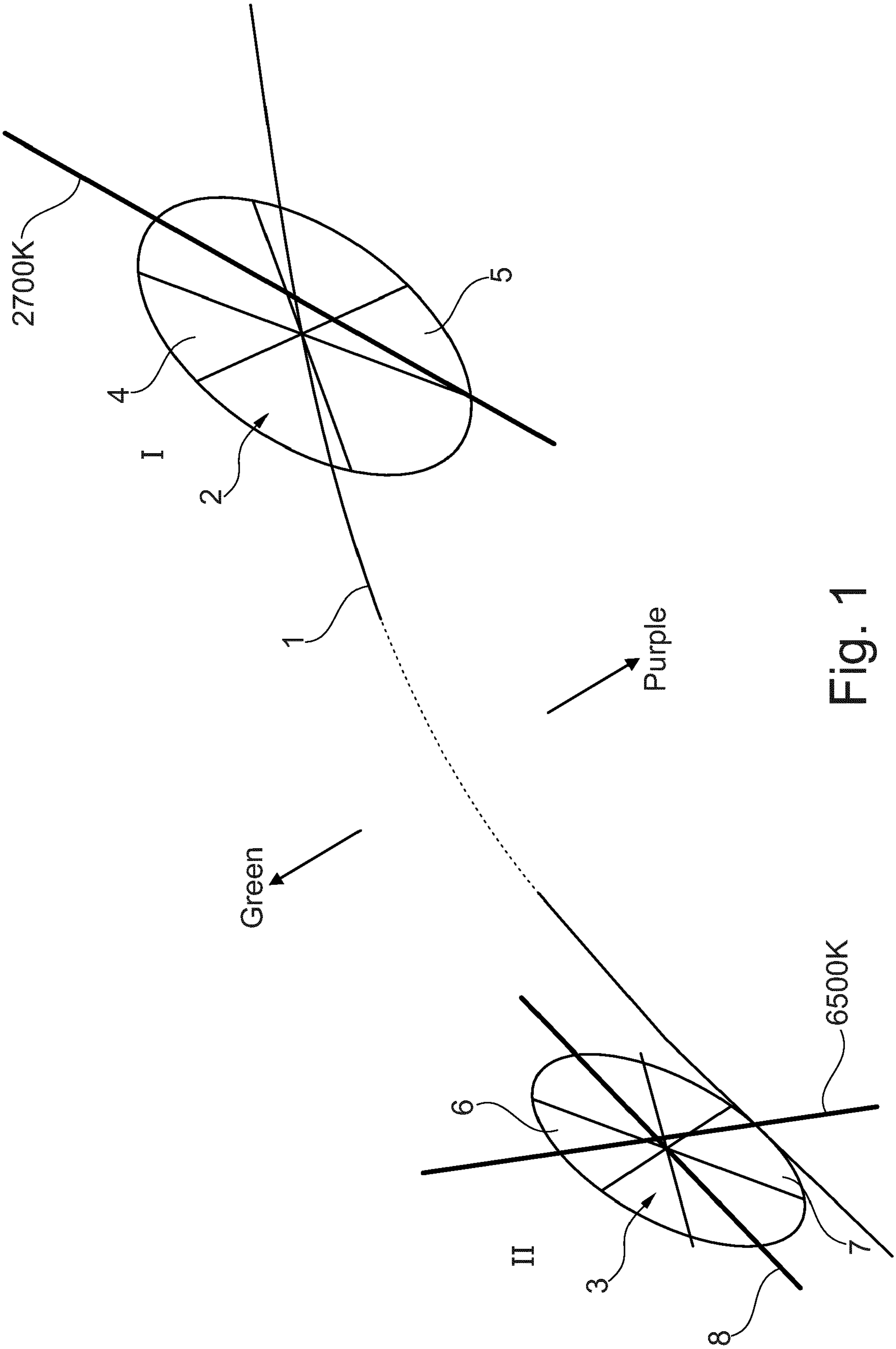

Fig. 1

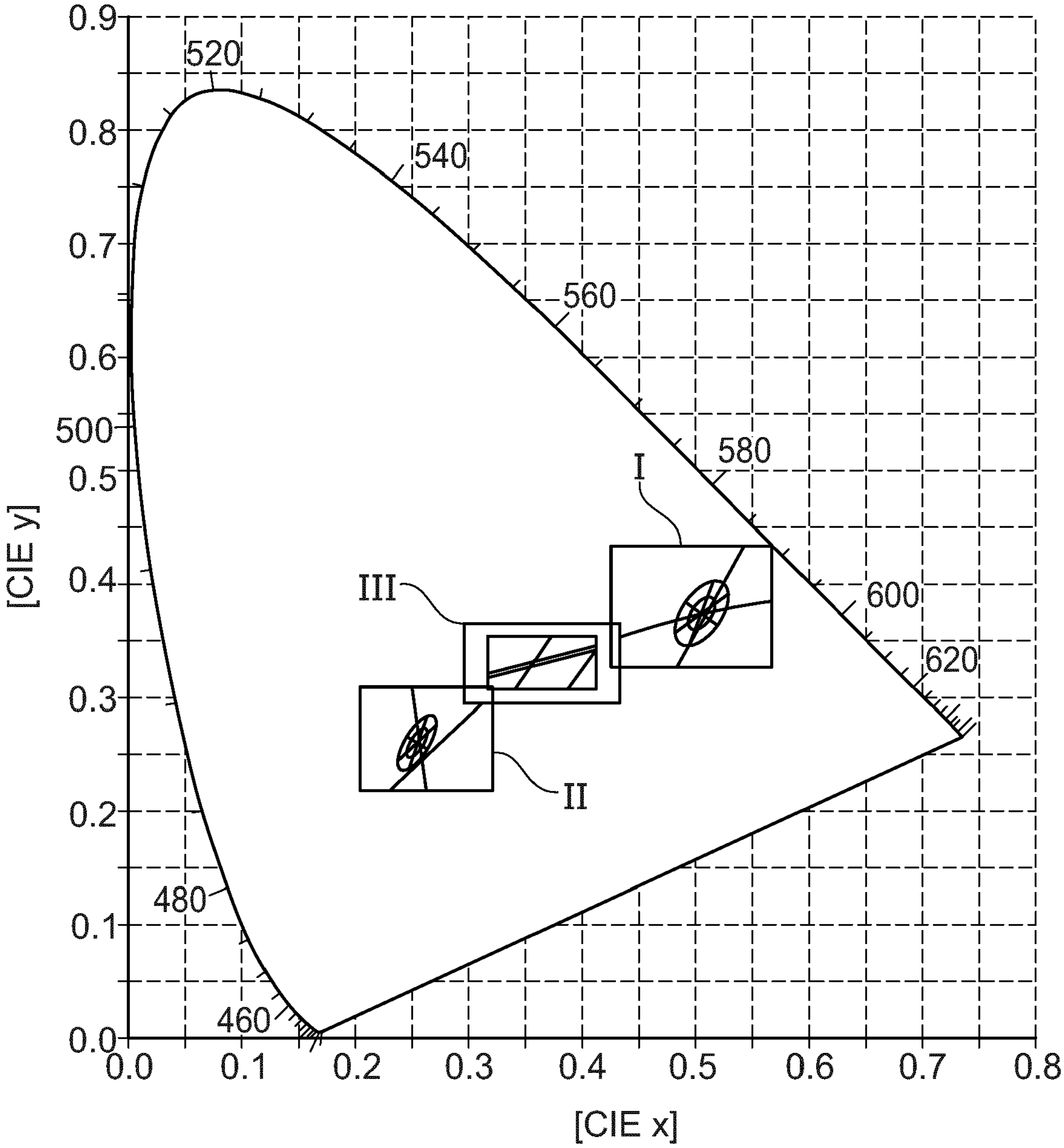
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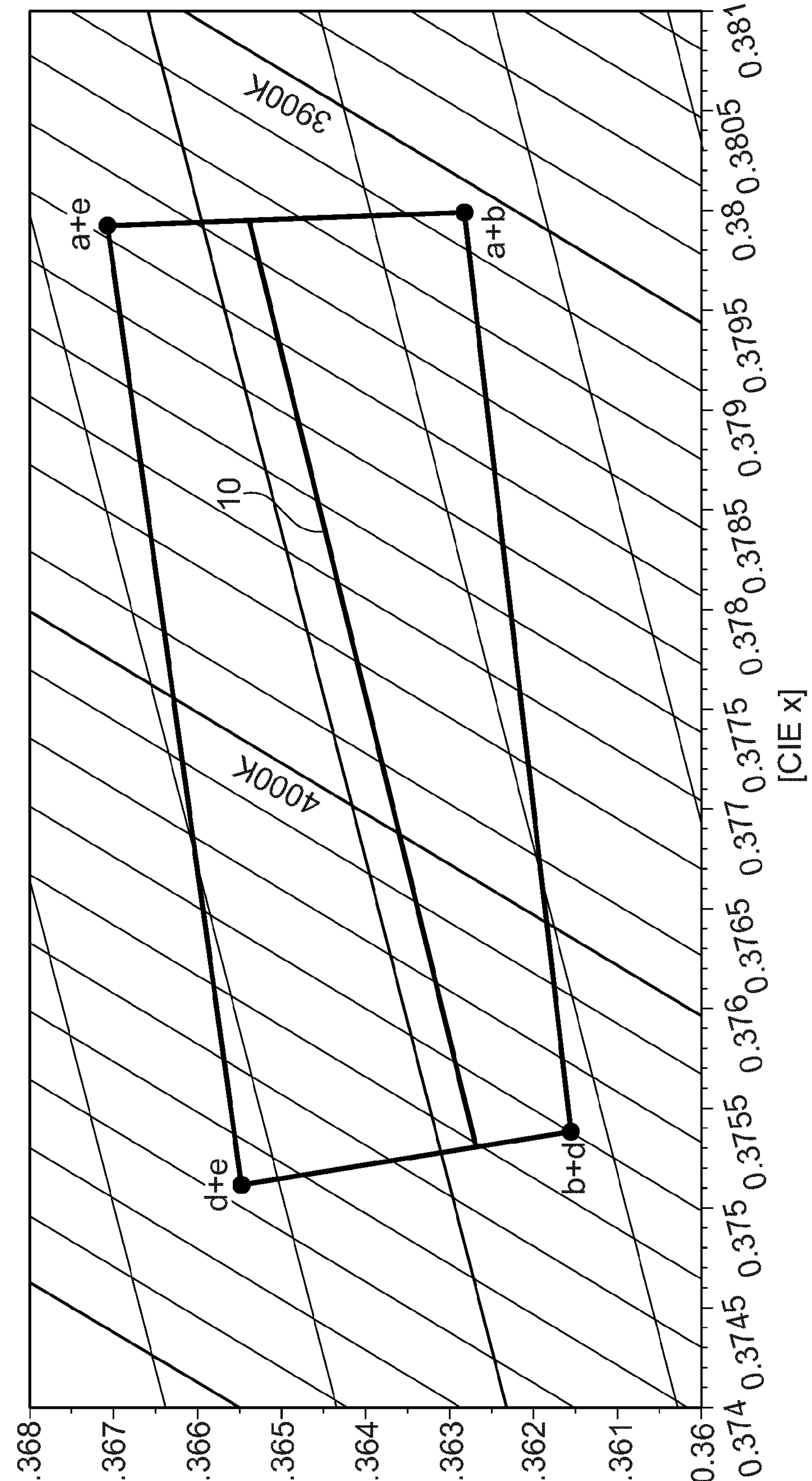
Fig. 2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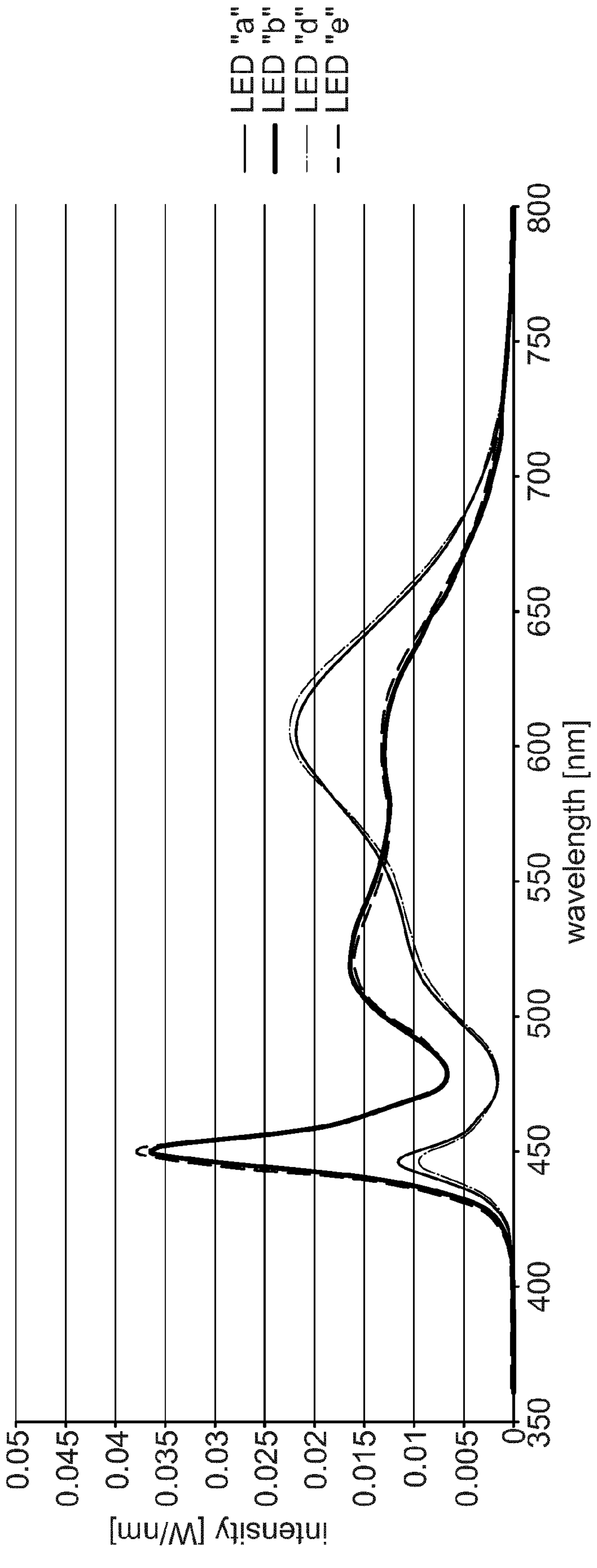
0.368

Fig. 3



LED "a"
LED "b"
LED "d"
LED "e"
intensity [W/nm]
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
350
400
450
500
550
600
650
700
750
800
wavelength [nm]

Fig. 4

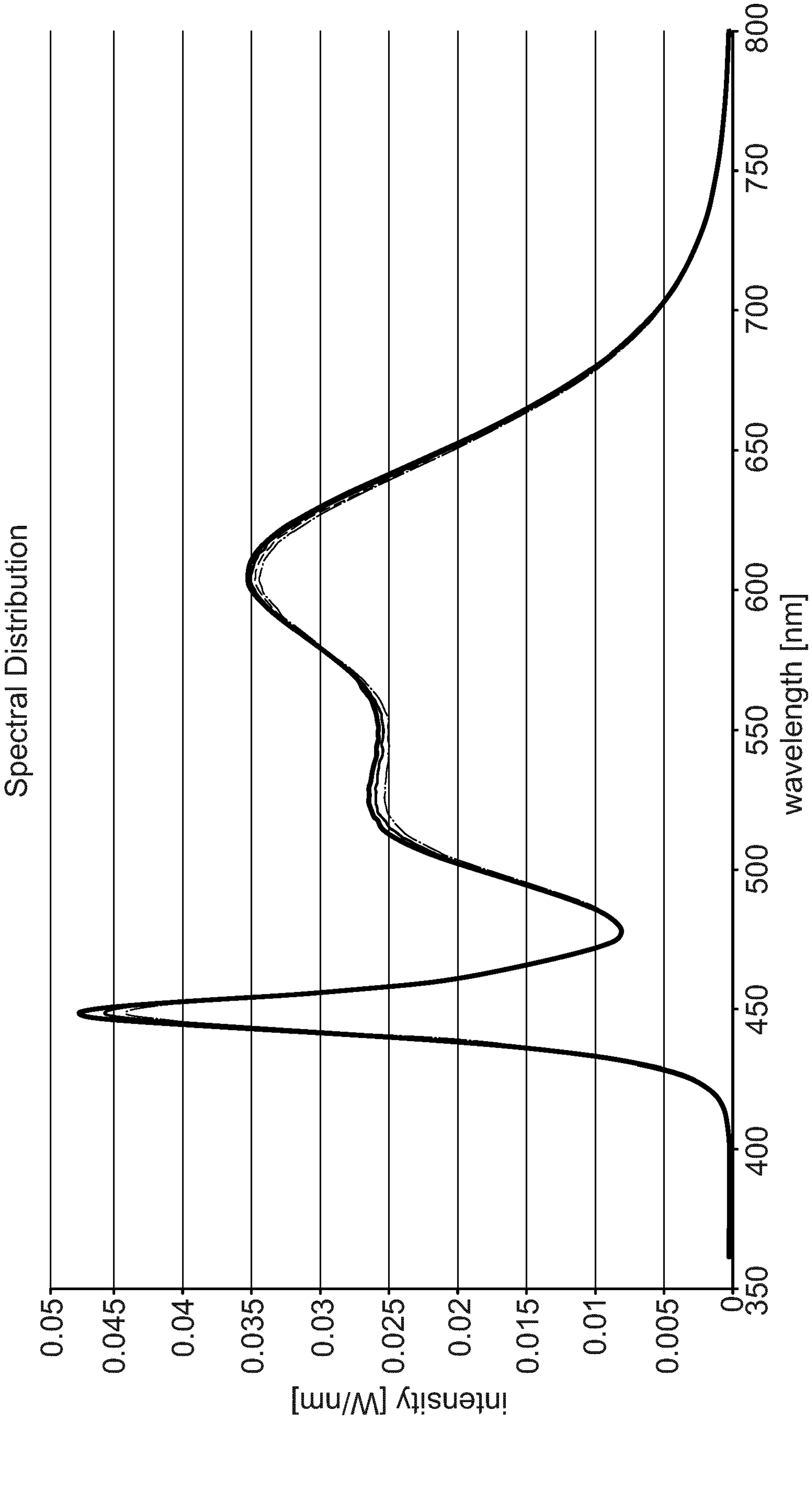

Spectral Distribution
intensity [W/nm]
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
350
400
450
500
550
600
650
700
750
800
wavelength [nm]

Fig. 5

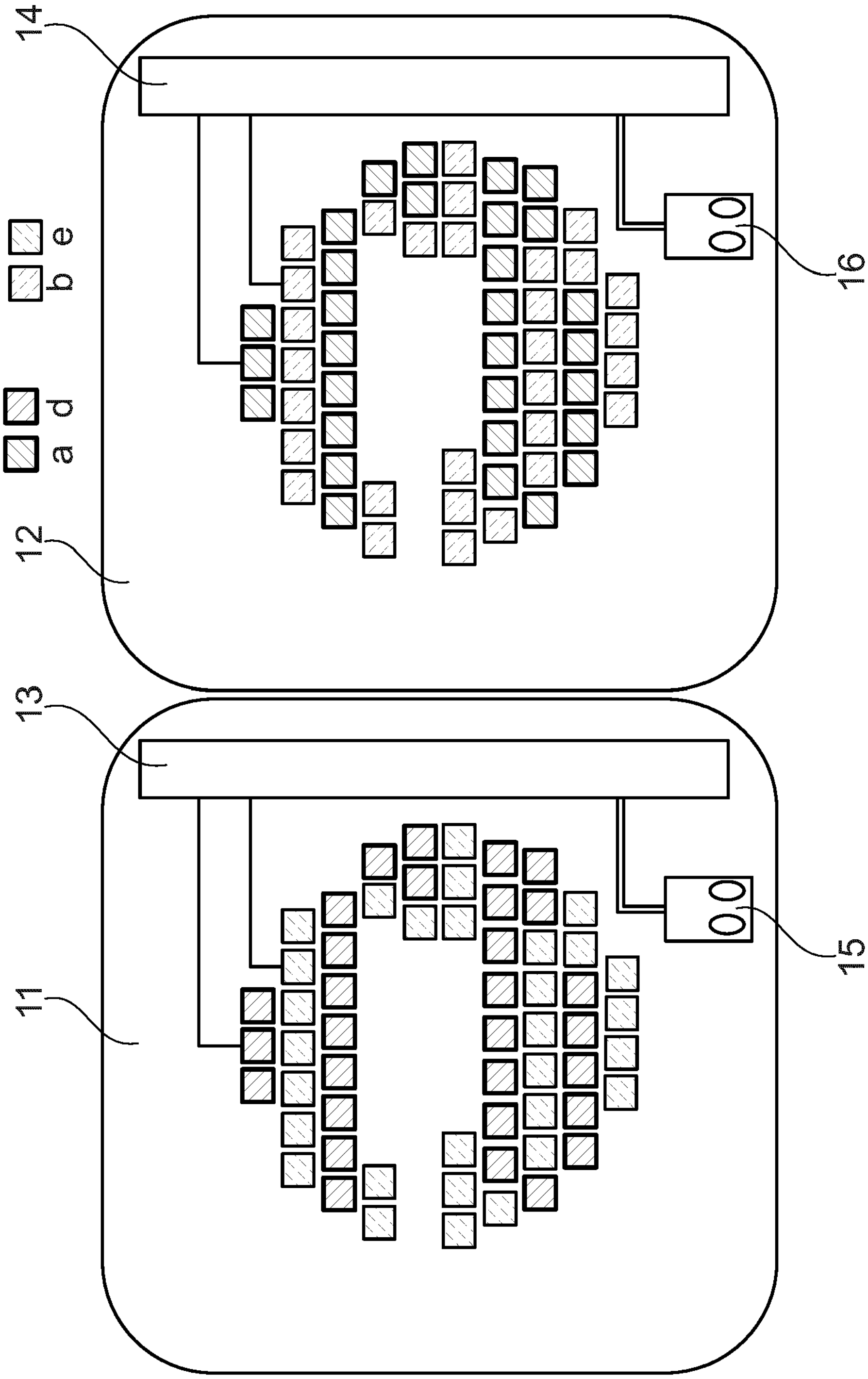


Fig. 6

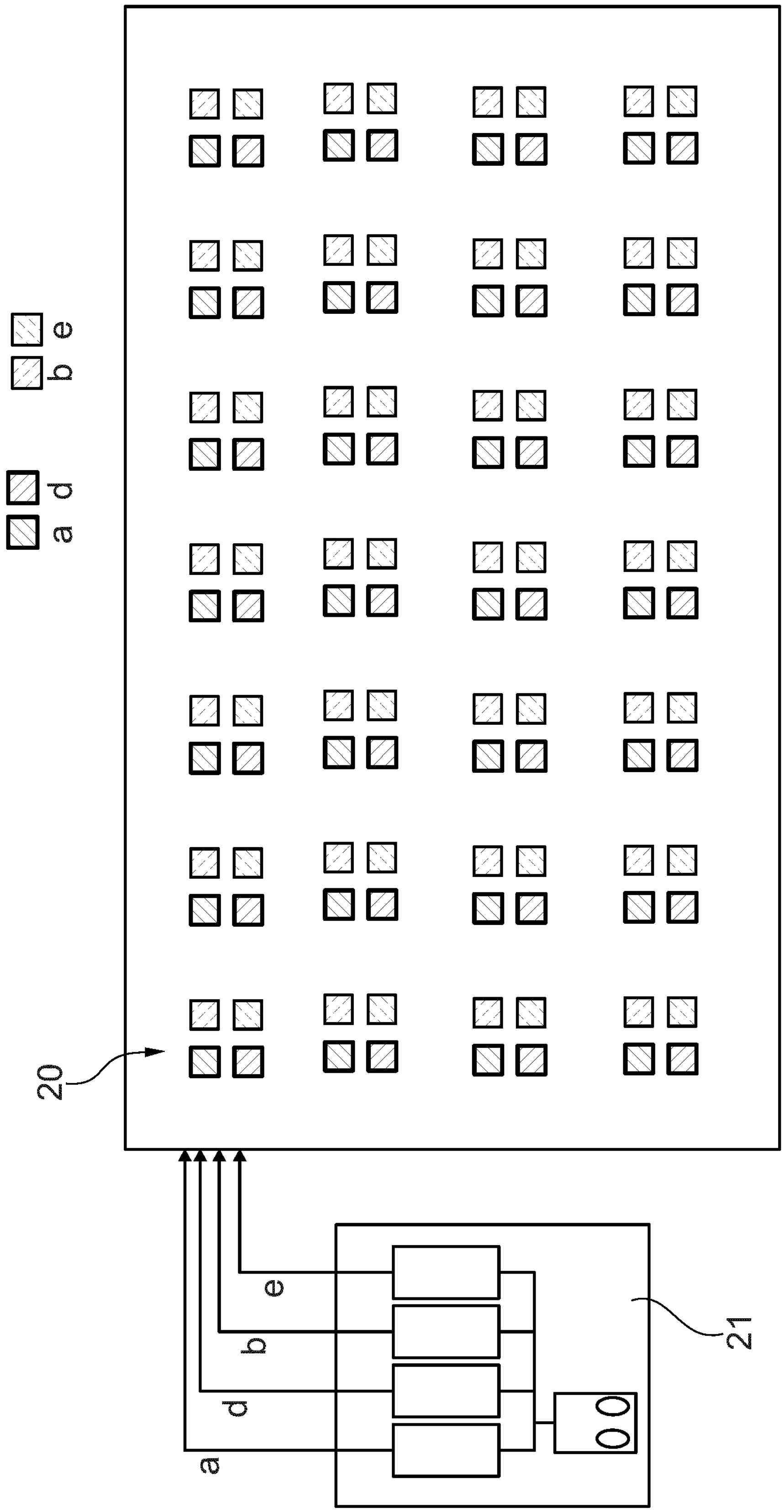


Fig. 7

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EUROPEAN SEARCH REPORT

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EP 22 15 7282

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			H05B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 July 2022	Henderson, Richard

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