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(54) Modular street lighting apparatus

(57) A street lighting apparatus comprising LED light sources and being provided to illuminate a street surface, said street surface having a predetermined width and a predetermined length, wherein the street lighting apparatus is provided to receive n sets of LED light sources, n being an integer ≥ 2, and said LED light sources form m sets of LED light sources, m being an integer ≥ 1 and m ≤ n, said m sets are received by said apparatus, whereby said apparatus is configured in such a manner that each of said m sets is provided to illuminate a partial surface of said street surface, said partial surface having said predetermined length and a fraction of said predetermined width, whereby said apparatus is furthermore configured so that different ones of said m sets are provided to illuminate different segments within said street surface.

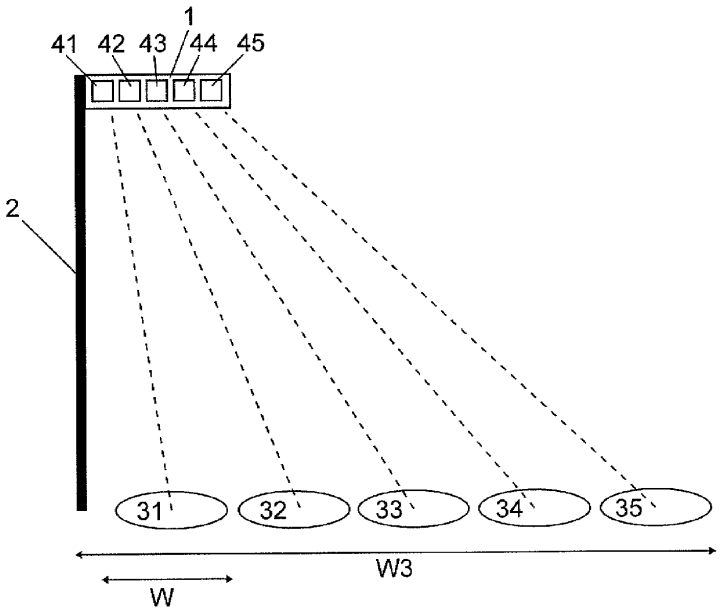

Fig. 2

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Description

[0001] The present invention concerns a street lighting apparatus comprising LED light sources and being provided to illuminate a street surface, said street surface having a predetermined width and a predetermined length.

[0002] Street lighting is known for a long time and rules have been established regarding the illumination of streets. An example of such a rule is that the street lighting may not illuminate beyond the width of the streets onto private property. The reason for such rule is that it is not acceptable for an owner of a house that the street lighting shines into its windows. However roads, pavements and curbs do form part of the street to be illuminated, and the lighting should illuminate these parts of the street as well. A further example of such a rule is that there exists a so-called uniformity requirement, which is a requirement regarding the maximal allowed differentiation in light intensity over the illuminated surface. The height and the distance between adjacent street lighting apparatuses, and the above mentioned and other rules to be followed, are defined in standards for illuminating streets.

[0003] However there are different types of streets, for which different requirements have been established regarding for example uniformity and intensity of the illumination. Furthermore, different types of streets may have different widths depending on the amount of lanes and on the presence or absence of pavements and/or curbs. This forms a problem when designing lighting apparatuses since a different apparatus, illuminating a different width and/or a different intensity, is to be configured for each different situation.

[0004] To overcome this problem, a conventional street lighting apparatus is provided with means so that the width of the illuminated surface can be amended when installing the street lighting apparatus. Such known conventional apparatus is therefore provided with a light source that is moveably mounted with respect to secondary optics like mirrors so that by moving the light source with respect to the optics, the width of the illuminated surface can be changed. Such street lighting apparatus is thereby applicable in a wide variety of types of streets, which economically is an advantage.

[0005] Conventional illumination means have the drawback that the energy consumption is high with respect to LED light sources. Therefore, several lighting apparatuses have been designed using LED light sources. Using LED light sources, appropriate heat management is required for preventing the LED light sources from overheating. Therefore in practice, the LED light sources are mounted onto a structure with high thermal conductivity that is thereby capable of transferring the heat away from the LED light sources. Furthermore, tests have shown that using a plurality of LED light sources is economically more interesting than using one LED light source. These LED light sources are configured to illuminate a street surface having a predetermined width and a predetermined length.

[0006] A drawback of these lighting apparatuses using LED light sources is that, since these LED light sources are mounted in close contact with a substantially rigid structure for heat management purposes, the means for amending the width, known from the conventional illumination means, can not be applied. The LED light sources can not be mounted in a random position with respect to secondary optics, and certainly not moveably with respect to secondary optics, because of the requirement of heat transfer away from the LED light sources. Therefore, the width, intensity and the uniformity of the illumination can not be amended on site. Thus for each type of street and street having a different width, there should be designed a different lighting apparatus, which is an economical drawback.

[0007] It is an object of the present invention to provide a lighting apparatus with LED light sources that is provided so that the width and/or the uniformity of the illuminated surface can be amended on site.

[0008] To this end, the street lighting apparatus according to the present invention is characterised in that said LED light sources form M sets, M being an integer ≥ 1, and the street lighting apparatus is provided to receive N of said sets, N being an integer ≥ 2 and $M \leq N$, said M sets are received by said apparatus, whereby said apparatus is configured in such a manner that an m^{th} ($1 \leq m \leq M$) set is provided to illuminate an m^{th} partial surface of said street surface, each partial surface having said predetermined length and an N^{th} fraction of said predetermined width.

[0009] Because the street lighting apparatus is provided to receive a number of N sets of LED light sources, depending on the situation on site, a particular set can be mounted or not. Thereby, more or less sets can be mounted on site. This provides the apparatus with a modular setup whereby modules, in this context being formed by sets of LED light sources, can be added or removed upon the requirements of each particular situation. The width of the street surface to be illuminated is furthermore fractioned into N fractions. Thereby, each of the N fraction can be assigned to each of the N sets.

[0010] A set of LED light sources is configured to illuminate a surface which differs from the street surface in that it is has a smaller width. Thereby, a set of LED light sources is provided to illuminate an elongated surface laying parallel to the axe of the street, which elongated surface only covers a part of the total width of the street surface but does cover substantially the whole length of the street surface to be illuminated by that lighting apparatus. Furthermore, the apparatus is provided such that different ones of said N sets are provided to illuminate different segments within the street surface. This results in that the street surface can be illuminated as a whole by illuminating a combination of segments of that street surface laying adjacent to each other so that the combination of segments together result in that the whole of the street surface is illuminated. In this regard, it is noted

that the term street surface refers to the maximal surface which can be illuminated when the number M, representing the number of sets of LED light sources that are mounted into the apparatus, is equal to the number N, representing the amount of sets that can be mounted in the apparatus. If N is equal to M, the maximal amount of sets is mounted in the apparatus and thus the maximal street surface can be illuminated. Because of the modular setup of the apparatus, streets having a different width, in particular smaller than the width of the above mentioned maximal street surface, can be illuminated as well by the apparatus according to the invention simply by mounting fewer sets of LED light sources in the apparatus than the maximal amount of sets N. Also a street where less uniformity is required than the above mentioned maximal street surface can be illuminated by the apparatus according to the invention by alternately mounting the sets of LED lights sources in the apparatus. Thereby, the apparatus provides in the possibility to amend the width and uniformity of the light bundle and thus of the illuminated surface on site. Furthermore the apparatus is applicable in a plurality of different situations, which is an economical advantage.

[0011] Preferably, each of said LED light sources comprises a lens provided for converging a light beam generated by the respective LED light source into a predetermined direction and with a predetermined divergence. For LED light sources, the direction and divergence of the light beam can be designed through the intermediary of a lens. Using a lens, the light beam can be directed into a direction which forms an angle with the direction perpendicular to the supporting surface of the LED light source. Thereby, the direction of the light bundle can be amended. Furthermore, the divergence can be amended via a lens. For example, a spot-shaped light bundle can be obtained or an elongated light bundle can be obtained through the intermediary of a lens on a LED light source. Since the LED light source in practice is mounted onto, and in close contact with a substantially rigid support, using lenses for obtaining a predetermined light bundle is advantageous over other secondary optics like mirrors.

[0012] Preferably, said apparatus comprises a frame having N connection surfaces upon which said M sets are respectively mounted. Preferably, said frame is manufactured from a high thermal conductive material, in particular metal, so that heat produced by the LED light sources can be transferred away from the LED light sources via the connection surfaces. In this manner, the apparatus is provided with a structure that allows heat to be transferred away from the LED light sources so as to prevent overheating of the LED light sources. Furthermore, the efficiency of the LED light sources decrease when temperature increases. Therefore, appropriate heat management whereby heat can be transferred away from the LED light sources is an advantage.

[0013] Preferably, said apparatus is configured in such a manner that said m^{th} sets is provided to illuminate said m^{th} partial surface in one or a combination of the configurations a, b and c:

a. the lenses comprised by the LED light sources in said m^{th} set are provided to converge their respective light beams into spot-shaped light beams, and said m^{th} connection surface is shaped so that different ones of said LED light sources are inclined with respect to each other thereby directing their respective spot-shaped light beams onto different segments within said partial surface so that said partial surface as a whole is illuminated;

b. the lenses comprised by the LED light sources in said m^{th} set are provided to converge their respective light beams into spot-shaped light beams and said lenses are furthermore configured to direct different ones of said spot-shaped light beams onto different segments within said partial surface so that said partial surface as a whole is illuminated; and

c. the lenses comprised by the LED light sources in said m^{th} set are provided to convert the respective light beams into a strip-shaped light beam so that each of said respective light beams is provided to illuminate substantially the whole of said partial surface.

[0014] Each set is configured to illuminate an elongated surface laying parallel to the axe of the street which elongated surface has a width that is smaller than the width of the street. There are different configurations that can be applied for a set to illuminate such elongated surface. A first configuration is the so-called spot by spot configuration, which is applied in the claimed configuration a and b, whereby each LED light source provides a spot-shaped light bundle directed to a different segment within the elongated surface. A spot-shaped light bundle has the advantage that the intensity of the light is high so that one spot provides the respective segment of street surface to which that spot is directed with a sufficiently high light intensity. The directing of different light bundles to different segments can be obtained in two different ways. In a first way, which is applied in the claimed configuration a, the light bundles are directed by physically inclining the LED light sources with respect to each other. In a second way, which is applied in the claimed configuration b, the light bundles are directed by providing them with lenses that deflect the light bundles in different directions. In a second configuration, which is applied in the claimed configuration c, each LED light source is provided with a lens so that each light bundle illuminates substantially the whole of the elongated surface. An advantage of such configuration is that no further directing of the light beams in a set is required. However in such configuration, one LED light source will in most cases not suffice to obtain a sufficiently high light intensity. Therefore multiple LED light sources all illuminating substantially the same surface are provided to obtain the required intensity.

[0015] Preferably, said apparatus is configured so that

said m^{th} set is provided to illuminate said m^{th} partial surface in one or a combination of the following configurations:

d. the lenses comprised by the LED light sources in said m^{th} sets are provided to direct their respective light beam onto said m^{th} partial surface; and
e. said m^{th} connection surface is inclined so that the light beams in said m^{th} set are directed onto said m^{th} partial surface.

[0016] Directing the light bundle of a set, which light bundle is formed by the combination of all light bundles coming from the LED light sources in that set, can be obtained in substantially two different ways. In a first way, which is applied in the claimed configuration e, the sets are physically inclined with respect to each other so that different sets illuminate different segments within the street surface. In a second way, which is applied in the claimed configuration d, the sets are not, or only little, inclined with respect to each other but the LED light sources in different sets are provided with different lenses that are provided to direct the light bundle coming from LED light sources in one set to a different segment in the street surface than the light bundle coming from LED light sources in another set. In this second way, the lenses direct the light bundle whereas in the first way, the physical position directs the light bundle. It will be clear that combinations of the above mentioned configurations also fall within the scope of protection of the present invention since it will be possible to obtain the result sought in the invention by such combinations.

[0017] The invention will now be described in more details with respect to the drawings illustrating some preferred embodiments of the invention. In the drawings:

figure 1 shows different types of streets with street lighting apparatuses;
figure 2 shows a side view of a street lighting apparatus according to the invention illuminating a street surface;
figure 3 shows a set of LED light sources in the street lighting apparatus according to the present invention;
figure 4 shows the different streets of figure 1 both illuminated with a street lighting apparatus according to the present invention;
figure 5 shows an upward view of a frame with connection surfaces of the street lighting apparatus according to the invention;
figure 6 shows a side view of a frame with inclined connection surfaces of the street lighting apparatus according to the invention;
figure 7 shows a side view of a frame with connection surfaces of the street lighting apparatus according to a further embodiment of the invention.

[0018] In the drawings a same reference number has been allocated to a same or analogous element.

[0019] Figure 1 shows different types of streets. In figure 1a, a street is shown having two driving lanes L1 and L2, and a raised pavement on both sides of the street P1 and P2. In figure 1b, a street is shown having four driving lanes L1, L2, L3 and L4, and a hard shoulder for emergency stop S1 and S2 on both sides of the street. It will be clear that the total width to be illuminated in the street in figure 1a, indicated with W1, is smaller than the street in figure 1b, indicated with W2. Further street configurations can be formed by one, two, three, four, five or six driving lanes, having no, one or two pavements, having no, one or two hard shoulders and having no, one or two side strips. Preferably the street lighting apparatus according to the present invention is provided to illuminate the street surface of all these street configurations without substantial modifications to the apparatus. Thereby, it is noted that a street lighting apparatus may not illuminate beyond the width of the street onto for example private property because this provides discomfort and privacy issues to the owner of the illuminated property.

[0020] Streets are illuminated by a series of lighting apparatuses 1 that are placed along the streets at predetermined intervals I. The lighting apparatuses 1 are mounted onto poles 2 having a predetermined height H. The height H and interval distance I are determined by law and/or by established standards. In the further description, the illumination coming from the apparatus will be described referring to the illuminated street surface. It will be clear that based on the mathematical relationship between on the one hand the predetermined height H and predetermined intervals I and on the other hand the illuminated surface, the angle and divergence of the light bundle at the height of the apparatus can be calculated by a skilled person. A skilled person will therefore be able to design a lighting apparatus based on the description given below. Furthermore because of the height H and interval distance I being predetermined, infringement can be unambiguously judged.

[0021] In most countries, the predetermined height H and the interval distance I is independent from the type of street. Thereby, considering the length of the street, all street lighting apparatuses should illuminate a same length L of street surface, the length L being substantially equal to the interval distance I. However the width of the street surface to be illuminated can differ from street to street as explained above in reference to figure 1. Furthermore, different uniformity requirements are prescribed for different types of street.

[0022] Figure 2 shows a side view of a street lighting apparatus 1 according to the invention, which is mounted on a pole 2. The street lighting apparatus is provided to illuminate a street surface having a width W3 and a length L. The figure 2 shows how the street surface is illuminated by illuminating adjacent segments within the street surface.

[0023] Each of the different segments 31, 32, 33, 34 and 35 is illuminated by a different set of LED light sourc-

es 41, 42, 43, 44 and 45 mounted within the lighting apparatus 1. Figure 2 thereby shows a lighting apparatus where the number of sets M in the apparatus is five. Furthermore, the number of sets N that can be mounted in the apparatus is also five. Should the apparatus comprise a smaller number of sets M, the apparatus would still be provided to illuminate a street surface because there is the possibility to mount a further set so that M = N.

[0024] Although the figure shows a street lighting apparatus wherein a number N of five sets are mountable, it will be clear that for the invention, the number N is an integer equal to or greater than two. Preferably N is an integer greater than 2, more preferably an integer greater than 3, most preferably an integer greater than 4. Preferably, N is an integer smaller than 15, more preferably an integer smaller than 10, most preferably an integer smaller than 7.

[0025] The number M of sets that are mounted in the apparatus depends on the situation on site. Thereby, M is an integer equal to or greater than 1 and equal to or smaller than n. Preferably M is greater than 1, more preferably greater than two. The configuration shown in figure 2, whereby the maximal amount of sets is mounted in the apparatus 1, thus whereby M is equal to N, illuminates the maximal street surface that can be illuminated by that lighting apparatus. That maximal street surface has a length L and a width W3 that is substantially equal to the sum of the widths W of the M sets that are mounted in the apparatus.

[0026] Each set is provided to illuminate a segment of the maximal street surface, which segment has a length L that is substantially equal to the length L of the maximal street surface that can be illuminated and a width W that is a fraction of the width W3 of the maximal street surface that can be illuminated.

[0027] The apparatus as shown in figure 2 allows to optimally illuminate streets with different widths and different uniformity requirements. The configuration of the apparatus can be amended on site depending on the situation by mounting or not mounting particular sets in the apparatus. Example 1: a street with a large width and a high uniformity requirement can be illuminated by mounting all 5 sets 41, 42, 43, 44 and 45 in the lighting apparatus so that the maximal street surface is illuminated by illuminating the segments 31, 32, 33, 34 and 35. Example 2: a street with a large width and a low uniformity requirement can be illuminated by mounting three sets being the 41, 43 and 45 in the apparatus so that the street segments 31, 33 and 35 are illuminated. Thereby, the intensity of the light in the segment 32 and 34 will be lower than in the segment 31, 33 and 35 but the width of the street surface that is illuminated is substantially equal to that of the maximal street surface. Example 3: a street with a smaller width and a high uniformity requirement can be illuminated by mounting three sets being the 41, 42 and 43 so that the street segments 31, 32 and 33 are illuminated. Thereby, a street surface having a smaller width than the width W3 of the maximal street surface is illuminated. Example 4: a street with a smaller width and a low uniformity requirement can be illuminated by mounting two sets being the 41 and 43 so that the street segments 31 and 33 are illuminated. Thereby, the width of the street surface that is illuminated is equal to the width illuminated in example 3, however the uniformity is lower since the intensity of light in the segment 32 will be lower. These examples indicate that very different streets can be illuminated using the same lighting apparatus, which is an economical advantage.

[0028] Figure 3 shows a set 4 of LED light sources 5, which set 4 is, when mounted in the apparatus 1, configured to illuminate a partial surface 3 of the street surface, being a segment of the street surface as shown in figure 2, and being an elongated surface laying parallel to the street axis and having a length L substantially equal to the length L of the street surface to be illuminated and a width W being a fraction of the width W3 of the maximal street surface that can be illuminated. The set comprises multiple LED light sources 5 that work together to illuminate the partial surface. To this end, the multiple LED light sources 5 can be configured in several configurations, each of which will be described hereunder.

[0029] In a first configuration, as shown on the left hand side in figure 3, the LED light sources are provided with a lens to convert the light beams coming from the LED light sources into spot-shaped light beams. Furthermore, the LED light sources are mounted onto a connection surface that is shaped so that different ones of the LED light sources are inclined with respect to each other thereby directing their respective spot-shaped light beams onto different segments within the partial surface so that the combination of LED light sources illuminate substantially the whole of the partial surface.

[0030] In a second configuration, as shown on the right hand side in figure 3, the LED light sources are provided with a lens to convert the light beams coming from the LED light sources into spot-shaped light beams, similar to in the first configuration. However in the second configuration, the directing of the light beams is not obtained by inclining the LED light sources, but by providing the LED light sources with further lenses 6 that directs the light beams respectively onto the different segments within the partial surface. It will be clear that the lens to obtain the spot-shaped light beam and the further lens to direct the light beam can be formed into one lens or can be formed by two different lenses.

[0031] In a third configuration, which is not shown, the LED light sources are provided with a lens to convert the light beams coming from the LED light sources into line-shaped light beams whereby each line-shaped light beam is provided to illuminate substantially the whole of the partial surface 3. Using a plurality of LED light sources in one set in such third configuration increases the intensity of the light in the partial surface.

[0032] Further configurations being combinations of two or three of the above mentioned configurations can be designed to have the same result as each of the above

mentioned configurations.

[0033] In this regard, it is noted that the directing of light beams into a predetermined direction can be obtained by physically inclining the light source or by providing the light source with a lens or by a combination of physically inclining and providing a lens. Furthermore, the shape of the light beam can be spot-shaped where substantially no overlap is necessary to obtain the required intensity, or line-shaped where substantially all light beams illuminate the same surface area to obtain the required intensity, or a shape in between the spot-shape and the line-shape where the light sources are to be directed to only partially illuminate the same area.

[0034] In figure 3, the set 4 of LED light sources 5 is shown having a number of twelve LED light sources 5. This number of twelve LED light sources 5 is only given as an example, and it will be clear that the number of LED light sources in a set can vary from 1 to 50, preferably from 4 to 40, more preferably from 6 to 30, most preferably from 8 to 20. In particular configurations, a set of LED light sources can be formed by only one or two LED light sources.

[0035] Figure 4 shows street surfaces similar to figure 1, and shows how one apparatus according to the invention can be configured to illuminate streets having different widths by mounting or mounting not particular sets of LED light sources. Figure 4a shows a street surface having a width W1 that is smaller than the maximal width W3 that can be illuminated by the apparatus. Therefore in figure 4a, the apparatus is not provided with the maximum amount N of sets, but with only a number M of three sets. Each of the sets illuminates partial street surface 3 being a segment of the street surface, the partial street surface having a length L and a width W. The combination of the three partial street surfaces together forms substantially the whole of the street surface to be illuminated. Thereby, the product of the amount of sets mounted in the apparatus and the width W of the partial surface is substantially equal to the width W1 of the street surface.

[0036] Figure 4b shows a street surface having a width W2 that is substantially equal to the width W3 of the maximal street surface that can be illuminated by the apparatus 1. Therefore, the number M of sets mounted in the apparatus 1 is five and thereby equal to the number N of sets that can be mounted in the apparatus 1. Each of the five sets illuminates a partial street surface 3 so that the combination of partial street surfaces 3 forms the street surface to be illuminated.

[0037] Figure 5 shows a view from underneath the street lighting apparatus 1 thereby showing the frame with the connection surfaces upon which the sets of LED light sources are mountable. In this context, it should be noted that although the LED light sources in a set are configured to work together to illuminate a partial street surface, there is no need for the LED light sources to be physically mounted adjacent each other. In the apparatus 1 as shown in figure 5, each set of LED light sources is divided in a so-called extensive part and a so-called intensive part. The extensive part of the set can be defined as that part of the set where the LED light sources illuminate a part of the street laying further away from the pole 2. The intensive part of the set can be defined as that part of the set where the LED light sources illuminate a part of the street laying more close to the pole 2 and thereby more underneath the apparatus. Referring to figure 3, showing one set of LED light sources, the extensive LED light sources are formed by the three outermost LED light sources on each side, thus six LED light sources in total, while the intensive LED light sources are formed by the six innermost LED light sources.

[0038] In figure 5, the intensive part of the set's are mounted in a first part 7 of the apparatus while the extensive part of the set's are mounted in a second part 8 of the apparatus. By separating the intensive and extensive parts, the layout and shape of the street lighting apparatus can be optimized. The shown apparatus is provided so that a maximal number N of four set's can be mounted. The mounting of the sets on the connection surfaces is preferably by snap-fit engagement so that on site, further sets can be easily mounted by snap-fitting the latter into the apparatus.

[0039] The shown apparatus is provided with a frame having a number of 16 connection surfaces 9 upon which LED light sources can be mounted. The LED light sources being mounted onto a surface can thereby easily transmit heat to the frame via the connection surface 9. Therefore, the connection surfaces provide in an effective manner to transfer heat away from the LED light sources. Although the connection surfaces are shown in the figure as elements loosely connected to a structure, the connection surfaces can be formed in many ways including separate elements and a rigid fixed structure. Preferably, the frame comprises the connection surfaces and the frame is manufactured from a high thermal conducting material such as steel. Preferably, the frame comprises, at its exterior, cooling fins which are configured to transfer the heat coming from the LED light sources via the connection surfaces and via the frame to the air surrounding the frame via the cooling fins.

[0040] In figure 5, a first set that can be mounted comprises four parts, each part to be connected to a respective connection surface 11, 12, 13 and 14. Thereby, the LED light sources mounted to the connection surfaces 11 and 14 will be the extensive LED light sources while the LED light sources mounted to the connection surfaces 12 and 13 will be the intensive LED light sources. The connection surfaces are inclined with respect to each other and are thereby formed to direct the light bundle of the LED light sources by inclining the LED light sources with respect to each other. Thereby, the apparatus as shown in figure 5 is applicable in a configuration as described above with reference to the first configuration.

[0041] A second set can be mounted, analogue to the first set, on the connection surfaces 21, 22, 23 and 24. These connection surfaces are inclined with respect to the respective connection surfaces 11, 12, 13 and 14

about an axis laying substantially parallel to the axis of the street. Thereby, the second set is directed to a partial street surface that lays further away from the pole of the apparatus, and adjacent the partial street surface that is illuminated by the first set. Each further set in the apparatus is further inclined so that the m^{th} set in the apparatus is provided to illuminate the m^{th} partial surface in the maximal street surface, as also shown in the figure 4.

[0042] In figure 5, each of the shown surfaces is provided to receive three LED light sources so that a set, being a combination of LEDs on four surfaces, comprises 12 LED light sources. The surfaces are preferably shaped so that the three LED light sources are somewhat inclined with respect to each other so that they illuminate adjacent segments in the partial surface, thereby applying the teaching as explained in relation to the left part of figure 3.

[0043] Figure 6 shows an embodiment which is applicable with a configuration of the sets of LED light sources as described above with reference to the second and third configuration. The m^{th} set of LED light sources 4 is in this embodiment directed to the m^{th} partial surface by physically inclining the set towards this m^{th} partial surface. In this configuration, the individual LED light sources in the set are directed to illuminate the partial surface using lenses, and the directing of the sets with respect to each other is obtained by physically inclining the sets with respect to each other.

[0044] Figure 7 shows an embodiment which is applicable with a configuration of the sets of LED light sources 4 as described above with reference to the second and third configuration. The m^{th} set of LED light sources 4 is in this embodiment directed to the m^{th} partial surface by providing a lens 6 to each LED light source 4 in the m^{th} set which lens directs the light onto the m^{th} partial surface. In this configuration, the individual LED light sources in the set are directed to illuminate the partial surface using lenses, and the directing of the sets with respect to each other is also obtained by using lenses. These lenses can be different lenses or can be integrated into one lens.

[0045] Regarding the figure 6 and 7, it is noted that the figure only shows one LED light source 4 per set. However the set preferably comprises a plurality of LED light sources.

Claims

1. A street lighting apparatus comprising LED light sources and being provided to illuminate a street surface, said street surface having a predetermined width and a predetermined length, **characterised in that** said LED light sources form M sets, M being an integer ≥ 1, and the street lighting apparatus is provided to receive N of said sets, N being an integer ≥ 2 and $M \leq N$, said M sets are received by said apparatus, whereby said apparatus is configured in such a manner that an m^{th} ($1 \leq m \leq M$) set is provided to illuminate an m^{th} partial surface of said street surface, each partial surface having said predetermined length and an N^{th} fraction of said predetermined width.

2. The street lighting apparatus according to claim 1, wherein each of said LED light sources comprises a lens provided for converging a light beam generated by the respective LED light source into a predetermined direction and with a predetermined divergence.

3. The street lighting apparatus according to claim 1 or 2, wherein said apparatus comprises a frame having at least N connection surfaces upon which said M sets are respectively mounted.

4. The street lighting apparatus according to claim 2 and claim 3, wherein said apparatus is configured in such a manner that said m^{th} sets is provided to illuminate said m^{th} partial surface in one or a combination of the configurations a, b and c:

    a. the lenses comprised by the LED light sources in said m^{th} set are provided to converge their respective light beams into spot-shaped light beams, and said m^{th} connection surface is shaped so that different ones of said LED light sources are inclined with respect to each other thereby directing their respective spot-shaped light beams onto different segments within said partial surface so that said partial surface as a whole is illuminated;
    b. the lenses comprised by the LED light sources in said m^{th} set are provided to converge their respective light beams into spot-shaped light beams and said lenses are furthermore configured to direct different ones of said spot-shaped light beams onto different segments within said partial surface so that said partial surface as a whole is illuminated; and
    c. the lenses comprised by the LED light sources in said m^{th} set are provided to convert the respective light beams into a strip-shaped light beam so that each of said respective light beams is provided to illuminate substantially the whole of said partial surface.

5. The street lighting apparatus according to claim 2 and 3, or according to claim 4, wherein said apparatus is configured so that said m^{th} set is provided to illuminate said m^{th} partial surface in one or a combination of the following configurations:

    d. the lenses comprised by the LED light sources in said m^{th} sets are provided to direct their respective light beam onto said m^{th} partial surface; and

e. said m^{th} connection surface is inclined so that the light beams in said m^{th} set are directed onto said m^{th} partial surface.

6. The street lighting apparatus according to any of the previous claims and claim 3, wherein said frame is manufactured from a high thermal conductive material, in particular metal, so that heat produced by the LED light sources can be transferred away from the LED light sources via the connection surfaces.

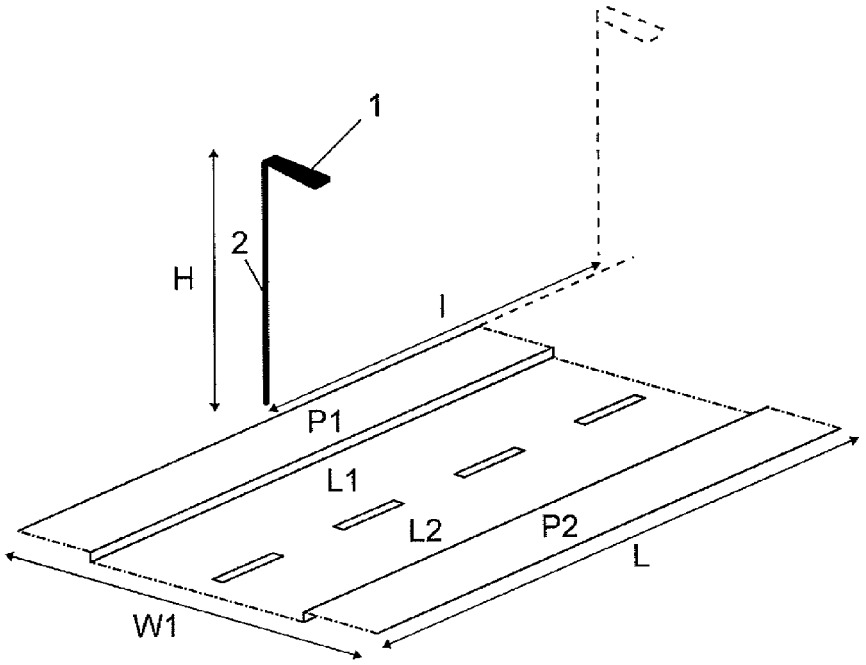

Fig. 1a

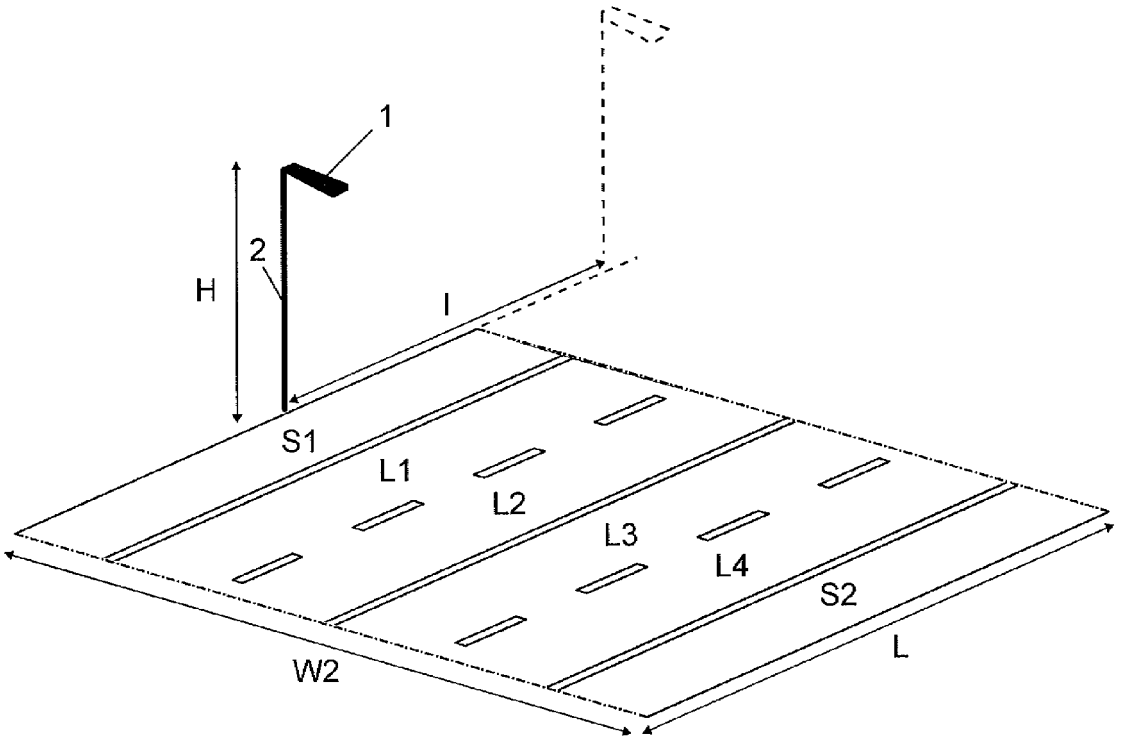

Fig. 1b

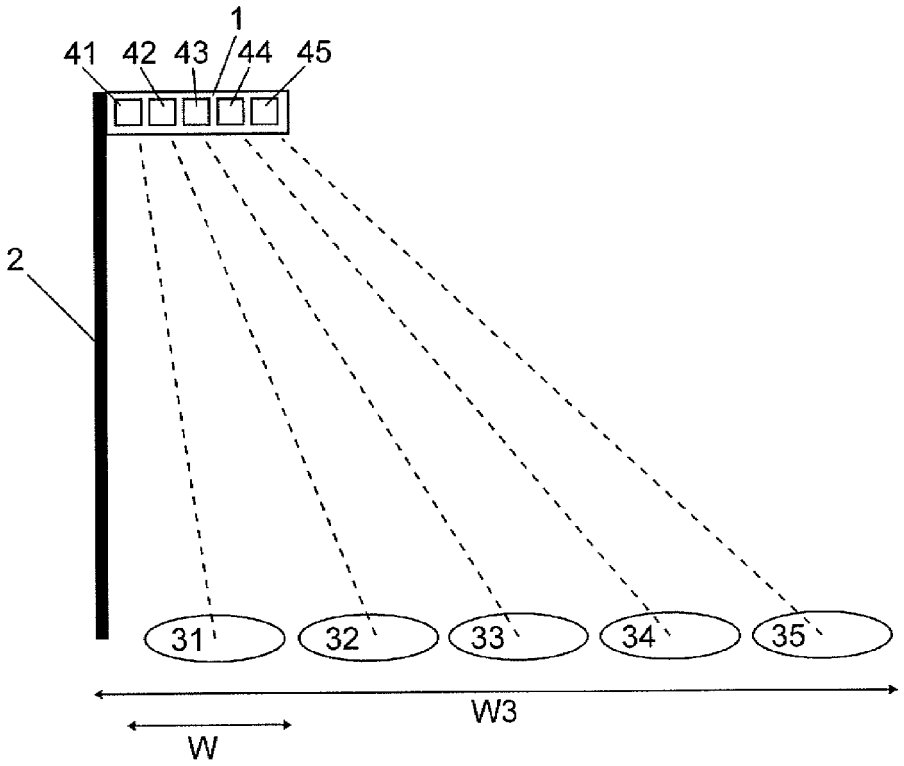

Fig. 2

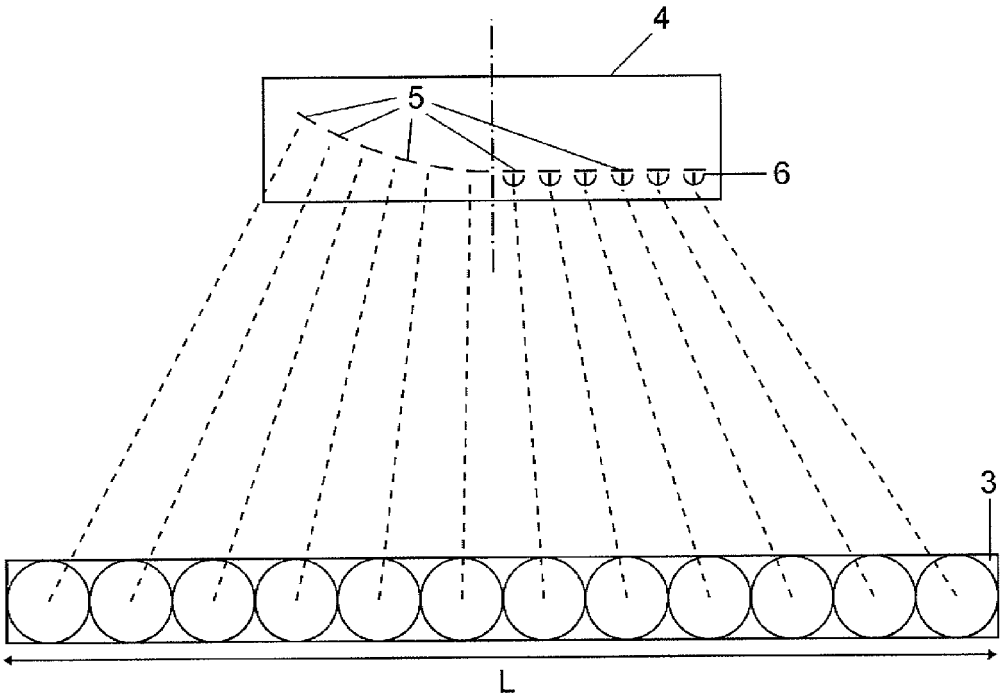

Fig. 3

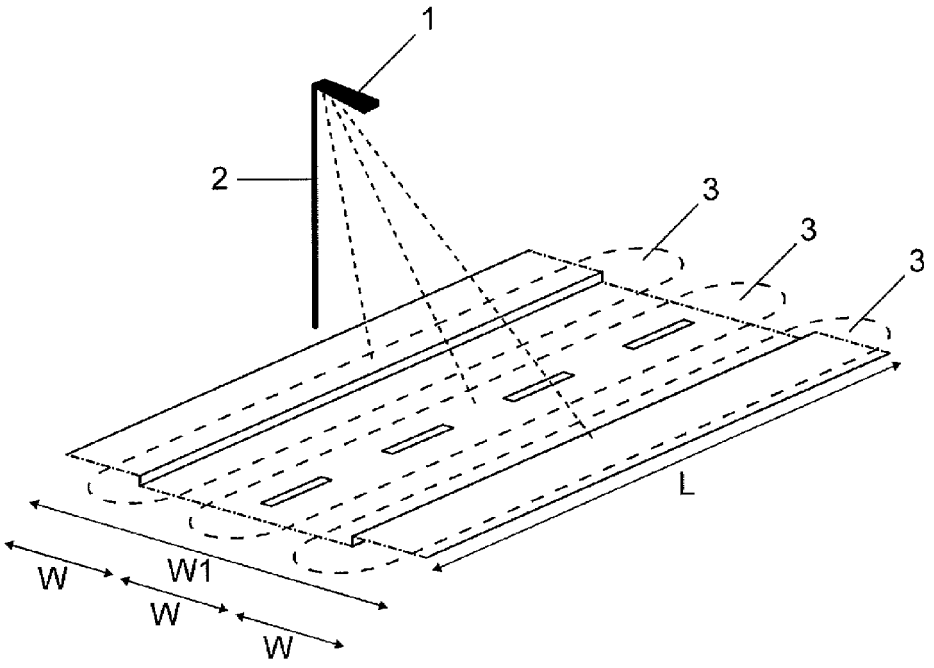

Fig. 4a

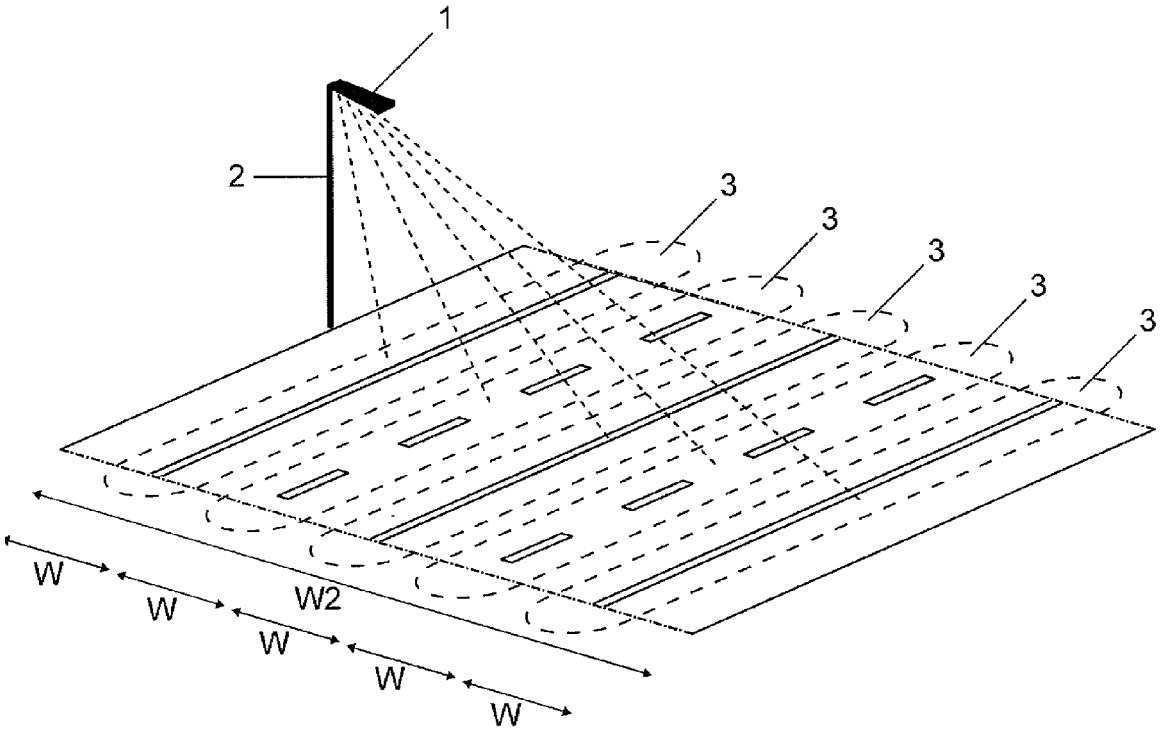

Fig. 4b

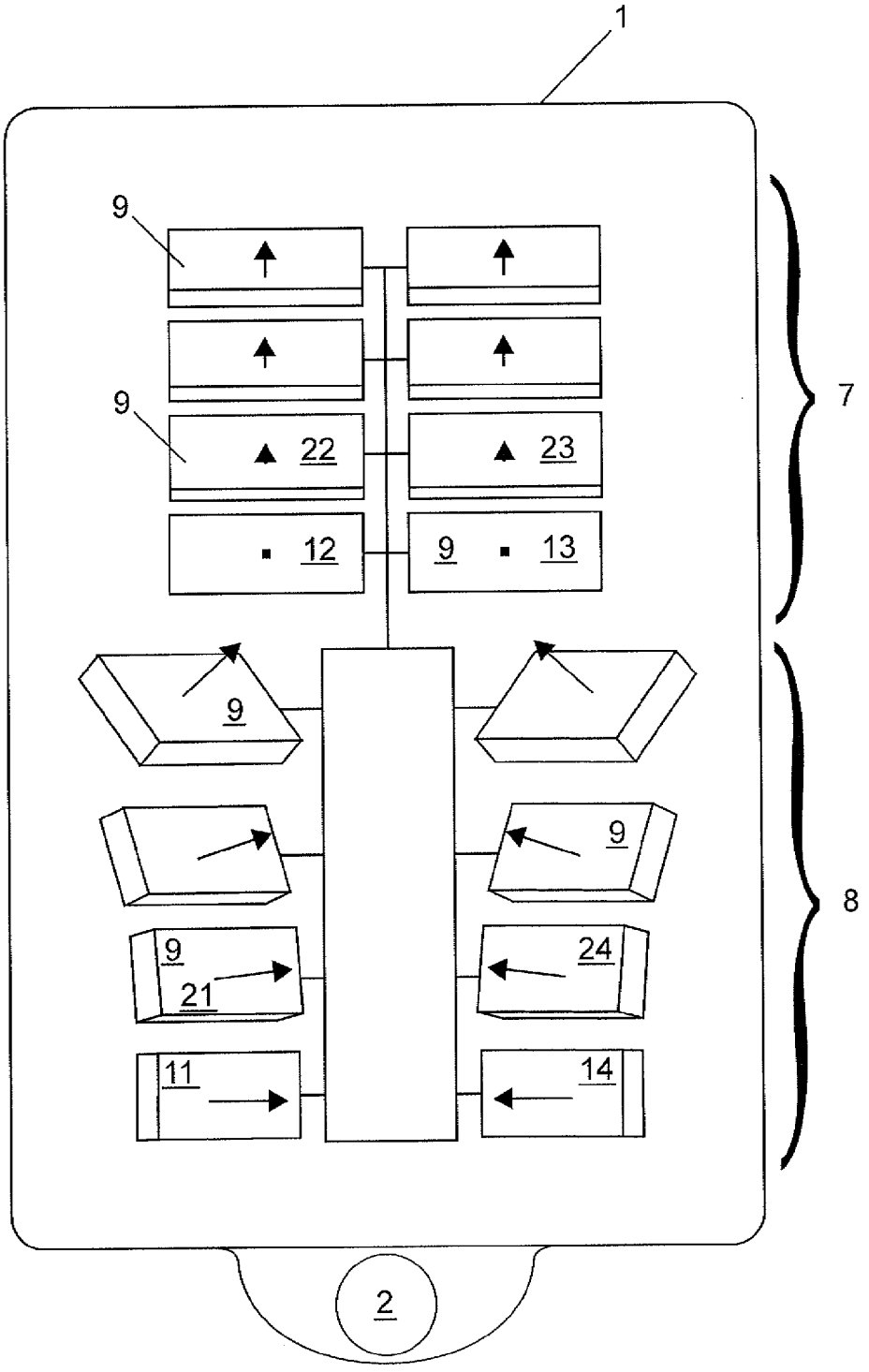

Fig. 5

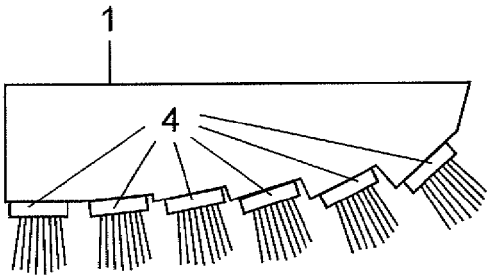

Fig. 6

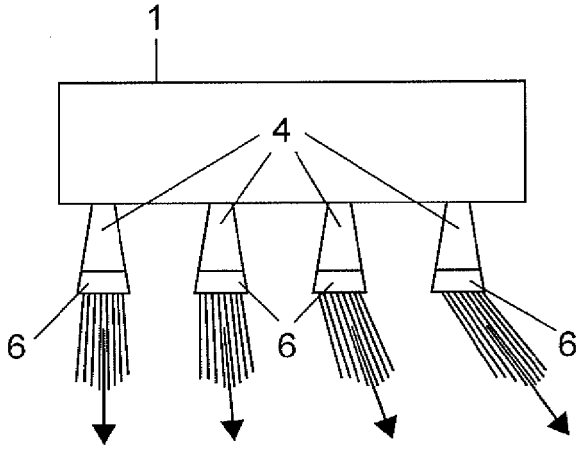

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 8739

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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
Munich	10 November 2010	Chaloupy, Marc

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