

## Light fixture

The invention relates to a light fixture for illuminating a building surface.

In particular, the invention relates to a light fixture for illuminating a building surface, the light fixture evenly illuminating a building surface with the aid of a spread lens plate.

The invention is based on a light fixture previously publicly used by the applicant and referred to as a lens wallwasher. Such a light fixture is mentioned, for example, on pages 342, 343, and 761 of the catalog „ERCO Product Range, Lighting Controls, Indoor Lighting, Outdoor Lighting, 2006/2007 Issue". The previously known light fixture comprises a reflector with a parabolic cross-section, the reflector being configured substantially rotational-symmetrically about the longitudinal center axis thereof.

Starting from the light fixture according to the applicant's state of the art, which became known through its prior public use, it is the object of the invention to further develop the known light fixture such that improved illumination of a building surface is possible.

The invention achieves this object with the characteristics of claim 1.

The inventive light fixture for illuminating a building surface comprises, according to the invention, a cup-shaped base

body having a light emission opening, a light source being disposed on the inside of the body, wherein indirect

lighting portions starting from the light source can pass through the light emission opening only after being reflected on reflector surfaces and direct lighting portions starting from the light source pass through said opening without reflection on reflector surfaces, wherein in the region of the light emission opening a spread lens plate is provided, which ensures that the lighting portions are spread in order to make the illumination of the building surface more even, and wherein the reflector surfaces comprise a wall section with a parabolic cross-section and a wall section with an elliptic cross-section.

A building surface as defined by the invention shall be any surface formed by a building wall, for example a building ceiling, a floor wall or a lateral building wall, and a partial building surface. Within the meaning of the present patent application, a light fixture for illuminating a building surface can be any indoor or outdoor light fixture. The light fixture according to the invention is preferably a wallwasher. The inventive light fixture can also be used to illuminate objects, such as artwork or goods.

The light fixture according to the invention comprises a base body configured in a cup shape. A cup-shaped base body is any base body having a substantially arched basic shape, which is open toward a light emission opening and which elsewhere is substantially closed. This may be a base body that is configured substantially symmetrically about an axis of rotation. In a

preferred embodiment of the invention, the base body is configured axially elongated, substantially cylindrically, particularly tub-shaped.

A light source is provided on the inside of the base body. Light is emitted by the light source, the light exiting the base body through a light emission opening of the base body. The light emission opening of the base body corresponds, for example, to the light emission opening of the light fixture or is located adjacent to the latter. In particular, it may be disposed directly adjacent to the light emission opening of the light fixture.

The light source is disposed such that both indirect lighting portions and direct lighting portions can pass through the light emission opening of the base body. Direct lighting portions within the meaning of the present patent application are such lighting portions which starting from the light source can pass directly through the light emission opening of the base body, without being previously reflected on reflector surfaces. Indirect lighting portions of the light source are those lighting portions which have been reflected at least once on reflector surfaces before they can pass through the light emission opening.

A spread lens plate is disposed between the light source and the light emission opening. A spread lens plate is understood as any substantially two-dimensional, preferably planar, under certain circumstances also arched body, which can ensure a spreading of the lighting portions. The spread lens plate spreads both the direct lighting portions and the indirect lighting portions. Spreading helps produce more uniform illumination of the

building surface. In this way, homogeneous distribution of the luminous intensity on the building surface to be illuminated can be achieved.

The spread lens plate is formed, for example, by a glass plate, which is configured to be smooth on one of the two sides and comprises cylindrical lenses on the other side. If a light beam impinges upon a cylindrical lens, the beam is spread into a long line as a function of the selected focal length of the cylindrical lens. This line is disposed at a right angle to the axial direction of the cylindrical lenses.

Similarly, the total of all lighting portions emitted by the light source and impinging upon the spread lens plate in the form of direct lighting portions or indirect lighting portions can be considerably spread.

With respect to the dimensions, the spread lens plate is selected such that

it covers the entire opening cross-section of the light emission opening. Viewed in the light emission direction, the spread lens plate may be disposed in front or behind the light emission opening of the base body or in the light emission opening of the base body.

On the inventive light fixture, the reflector surface is formed at least by two differently arched wall sections. A first wall section has a parabolic cross-section and a second wall section has an elliptic cross-section. This configuration of the reflector surfaces makes it possible to dispose the light source directly in the focal points or close to the focal points of both

the parabolic wall section and the wall section with the elliptic cross-section. This enables a luminous intensity distribution on the wall to be illuminated, wherein the parabolic shape and the elliptic shape of the corresponding wall section cross-section can be selected arbitrarily.

For example, with the inventive light fixture a particularly even luminous intensity distribution across the entire vertical height or only along part of the height of the building wall to be illuminated can be achieved. Alternatively, by appropriately orienting the building light fixture relative to the building surface to be illuminated, also a particularly homogeneous illumination in a direction horizontal to a floor surface can be achieved. Finally, a desired luminous intensity distribution can also be generated in any arbitrary spatial direction.

The inventive arrangement and combination of wall sections having parabolic and elliptic cross-sections with one another enable in particular also an asymmetrical luminous intensity distribution. Particularly when providing the building light fixture relatively close to the wall, the illumination of regions of the building surface to be illuminated that are removed from the light fixture can be achieved. As a result, luminous intensity distributions and particularly uniform, homogeneous illuminations of building surfaces can be achieved, which were not possible with the light fixtures according to the state of the art.

According to an advantageous embodiment of the invention, the base body has a tub-shaped configuration. This enables the use of fluorescent tube lamps, wherein also a plurality of lamps may be

accommodated axially behind one another in a common base body. It is also possible to provide a plurality of base bodies axially next to one another or to provide a plurality of light fixtures axially next to one another. In this way, particularly uniform illumination of a building surface across a nearly arbitrary axial extension can be achieved.

Even when providing only a single light fixture having a tub-shaped base body, luminous intensity distribution that extends in the axial direction can be achieved on the building surface to be illuminated. Finally, the tub-shaped configuration of a base body enables a simplified design.

According to a further advantageous embodiment of the invention, the light source is configured to be axially elongated. This enables the use of conventional, bright lamps from the state of the art.

According to a further advantageous embodiment of the invention, the spread lens plate ensures the spreading of the light in the axial direction. This, in conjunction with a tub-shaped base body, enables particularly uniform illumination of the building surface across a building surface region that extends in the axial direction.

According to a further advantageous embodiment of the invention, the base body and/or the wall sections are configured cylindrically. A cylindrical configuration within the meaning of the present patent application shall mean that the base body and/or the wall sections have a constant cross-section along the axial extension of the base body. This enables a simplified design since

in particular elongated profiles can be used as components for the design of the light fixture.

In this context, it shall be noted that the reflector surfaces can be provided directly by wall regions of the base body.

The reflector surfaces, however, may also be provided inside the base body. In the latter variant, the base body can also be formed directly by a housing of the light fixture.

According to a further advantageous embodiment of the invention, the spread lens plate comprises a plurality of ribs extending transversely to the axial extension to form cylindrical lenses. In this embodiment of the invention, the cylindrical lenses are preferably provided perpendicularly to the axial extension of the base body. While the wall sections, particularly the parabolic wall section and the elliptic wall section, extend along the axial direction and insofar ensure the desired luminous intensity distribution, particularly an extremely homogeneous illumination of the building surface, in a direction transversely to the axial direction, the luminous intensity distribution can be spread in the axial direction by disposing the cylindrical lenses along a direction transversely to the axial direction. This enables a uniform illumination of the building surface across a very large area.

According to a further advantageous embodiment of the invention, a metal halide lamp, particularly an HID lamp or a low-voltage halogen incandescent lamp, is provided. The use of such bright light sources enables particularly high luminous intensity levels to be achieved on the building surface to be

illuminated. In this way, even quite large building surface regions, which under certain circumstances may even be located relatively far from the light fixture, can be satisfactorily illuminated using a single light fixture.

The light source is preferably a fluorescent tube light source, which radiates in a 360° angle of circumference range about the center longitudinal axis thereof.

According to a further advantageous embodiment of the invention, the wall sections are made of metal, particularly of aluminum. This enables the use of lamps developing a lot of heat, such as metal halide lamps or low-voltage halogen incandescent lamps. In addition, the design of a light fixture according to the invention can be simplified in this way.

According to a further embodiment of the invention, the light fixture is configured as a wallwasher. In this way, an inventive light fixture can be provided relatively close to the building wall to be illuminated and a homogeneous illumination of the desired region of the building wall becomes possible.

According to a further embodiment of the invention, the light fixture is configured as an in-ground light fixture. When using the special parabolic and elliptic wall sections, the light fixture according to the invention can homogeneously illuminate building surface regions that are removed from the light fixture and close to the light fixture.

According to a further advantageous embodiment of the invention, the light source is disposed in the focal point or close to the focal point of the elliptic wall section and in the focal

point or close to the focal point of the parabolic wall section. In this way, the luminous intensity distribution on the building surface to be illuminated can be predicted with relative ease, wherein conventional, known lighting technology principles can be employed. In particular, it can be taken into consideration that the light source disposed in the focal point of the elliptic wall section emits indirect lighting portions, wherein these indirect lighting portions are bundled in a second focal point. With an appropriate geometrical configuration of the elliptic wall section and a light emission opening of the light fixture, optionally also by using a glass cover plate, the light source is designed such that the second focal point is located outside of the base body, which is to say in the light radiation direction behind the spread lens plate and/or in the region of the light emission opening of the light fixture, preferably in the region of a cover glass.

If the light source is provided in the focal point or close to the focal point of the parabolic wall section, the indirect lighting portions, which were emitted by the light source and reflected on the parabolic wall section, leave the base body along a parallel main radiation direction. The parabolic wall section is disposed in relation to the light source such that preferably a region of the building surface to be illuminated that is removed from the light fixture is illuminated with these indirect lighting portions. The wall section having an elliptic cross-section is provided such that the indirect lighting portions reflected by this wall section preferably illuminate a region of

the building surface to be illuminated that is located close to the light fixture.

According to a further advantageous embodiment of the invention, the light fixture uniformly illuminates the building surface. In this way, the desired illumination effect can be achieved in a particularly advantageous manner.

According to a further advantageous embodiment of the invention, the elliptic wall section extends along an angle of circumference region of between  $90^\circ$  and  $270^\circ$  around the light source. The elliptic wall section preferably extends along an angle of circumference region of approximately  $205^\circ$  around the light source. As a result, the elliptic wall section covers a larger angle of circumference region than the angle of circumference along which the parabolic wall section extends.

In relation to the basic shape of the reflector with the two wall sections and the light emission opening of the base body, the light source can be disposed such that, for example, an aperture angle of approximately  $70^\circ$  in relation to the focal point or the location of the light source is obtained, so that the elliptic wall section and the parabolic wall section jointly cover an angle of circumference region of approximately  $270^\circ$ .

According to a further advantageous embodiment of the invention, the parabolic wall section extends substantially along an angle of circumference region of between 20 and  $1009^\circ$ , preferably along an angle of circumference region of between 30 and  $909^\circ$ , more advantageously along an angle of circumference region of approximately  $709^\circ$ .

According to a further advantageous embodiment of the invention, the spread lens plate is oriented substantially transversely to a main illumination direction of the light fixture.

In particular, the spread lens plate is oriented at an incline to the wall to be illuminated.

The light fixture furthermore advantageously comprises a cover glass, particularly when it is configured as an in-ground light fixture. The spread lens plate can then be provided at an incline to the cover glass, particularly at an incline of an angle between 20 and 60°, further preferred at an incline of an angle of approximately 45°.

The elliptic wall section and the parabolic wall section may be connected to an intermediate element, which may be configured flat, for example in order to directly attach the two wall sections to one another and to compensate for variances in the radial distances in relation to the light source.

The invention furthermore relates to a light fixture for illuminating building surfaces according to claim 20.

The invention is again based on the light fixture described at the beginning, which is known by the prior public use by the applicant.

Also this invention is based on the object of further developing the light fixture according to the applicant's state of the art, which became known by prior public use, such that improved illumination of a building surface becomes possible.

The invention achieves this object with the characteristics of claim 20.

The light fixture according to the invention serves the illumination of building surfaces, particularly for the especially uniform and homogeneous illumination of large regions of building surfaces. Within the meaning of the formulation of claim 20 regarding the building surface, the formulation provided above can be used.

The light fixture comprises a reflector element, which is substantially configured in a cup shape. It is an arched, hollow reflector element, which is substantially configured in a tumbler shape. On the inside thereof, it is provided with a reflector surface. The reflector element is preferably made of metal, with press-formed aluminum being more preferred.

The reflector element extends along a center longitudinal axis from an apex region to a light emission opening. The element widens along the center longitudinal axis, which is to say the diameter of the reflector element increases as the distance to the apex region increases.

The reflector element preferably has a substantially parabolic cross-section. Furthermore, the reflector element is preferably cut along a cutting plane which is disposed at an incline to the center longitudinal axis of the reflector element.

The apex region is the region of the reflector element with the farthest distance from the light emission opening. In the apex region of the reflector element preferably a passage or an opening for a lamp is provided. Furthermore, in the region of the

apex and/or in the region of the free boundary region, the reflector element is preferably attached to a housing of the lamp.

On the inside of the reflector element at least one lamp can be provided. Conventional lamps, particularly metal halide lamps, such as HID lamps, can be used as the lamp.

The light source is preferably a punctiform light source.

The light emission opening of the reflector element is the opening through which the light must pass in order to reach the building surface to be illuminated. While in the case of a completely rotation-symmetrical reflector element the light emission opening has a circular contour, the light emission opening of the reflector element in the inventive light fixture is surrounded by an oval border due to a cutting plane that is inclined obliquely to the center longitudinal axis of the reflector element.

Both direct and indirect lighting portions can pass through the light emission opening. Indirect lighting portion refers to all those light beams which, starting from the light source, only pass through the light emission opening after being reflected on the inside of the reflector. Direct lighting portions are all light beams which can pass through the light emission opening without being reflected on the inside of the reflector. The building surface to be illuminated is therefore preferably illuminated by direct and indirect lighting portions.

When using a lamp, which is to say a lighting means, which in the main radiation direction of the lamp, namely in a direction along the center longitudinal axis of the reflector

element, comprises an opaque cap element, it is possible under certain circumstances that no direct lighting portions pass through the light emission opening. When using lighting means that can radiate also in the direction of the center longitudinal axis of the reflector element, advantageously also direct lighting portions impinge upon the spread lens plate.

In the region of the light emission opening, preferably directly in the light emission opening of the reflector element, a spread lens plate is provided. In

agreement with the above explanations provided for claim 1 and the claims referring back to it, a spread lens plate is a two-dimensional, particularly flat element, which is designed to be translucent and comprises a plurality of preferably cylindrical lenses. The spread lens plate serves the spreading of lighting portions along a single preferred direction. The spreading of the lighting portions helps produce a more uniform illumination of the building surface. In the simplest case, a plurality of rib-shaped elongated cylindrical lenses are provided on at least one side of the spread lens plate, which is made of glass, for example.

A spread lens plate as defined by the present patent application can be made of clear or slightly matt-finished glass, for example sheet glass. The cylindrical lenses can be provided on one or both sides of the spread lens plate. Cylindrical lenses can be formed by convex curvatures or curvatures with a concave cross-section. The cylindrical lenses are preferably configured continuous and extend from one boundary region of the lens plate to the opposite boundary region of the lens plate. In an alternative

embodiment of the spread lens plate, the cylindrical lenses are formed by a plurality of microlenses, which likewise ensure a spreading of the lighting portions.

On the inside of the reflector element a plurality of segments are provided, the segments each comprising a surface arched toward the interior of the reflector element. By providing a plurality of individual segments, it is possible to arbitrarily design the light radiation characteristics of the reflector element and in this way achieve a desired illumination characteristic. Particularly when using cylindrically configured segments it is possible to adjust the light distribution along a first direction in the desired manner. By using a spread lens plate, additional spreading and uniformity can be achieved along a second direction perpendicular to the first direction.

The invention recognizes that, in order to achieve uniform illumination of a

building surface, a reflector element can be configured to achieve a certain lighting characteristic along a first direction, regardless of the subsequent design and positioning of a spread lens plate. By optimizing the inside surface of the reflector element, which is to say the active reflection surface, the light radiation characteristic along the first direction can be influenced in the desired manner.

For example, when configuring the inventive light fixture according to claim 20 as a recessed light fixture or as a spotlight provided at the building ceiling, it may be desirable to uniformly illuminate a vertical wall. In order to also evenly illuminate

particularly low regions, which is to say regions close to the floor surface of the vertical wall, or even emphasize these regions, a different radiation characteristic of the light fixture may be desired than when particularly high regions, which is to say regions close to the building ceiling of the vertical building surface, are supposed to be illuminated. Both applications can be achieved by appropriately configuring the segments. It is also possible to illuminate very high, vertical building walls or surfaces across large areas close to the light fixture with the inventive light fixture.

Due to the provision of a plurality of segments, the inside surface of the reflector element can be designed arbitrarily. For example, a first angle of circumference region or partial region of the reflector element can imitate the light radiation characteristics of a reflector having a parabolic cross-section, and a different angle of angle of circumference region or another partial region of the inside of the reflector element can imitate the light radiation characteristic of a different reflector, for example a reflector having an elliptic cross-section. In this way, the building surface can be illuminated in an optimized, particularly homogeneous manner.

The inventive combination of a spread lens plate with a reflector comprising segments furthermore allows particularly dense luminance to be achieved on the outside of the spread lens plate or in the region of the light

emission opening of the light fixture. This reduces undesirable glare effects for the observer.

According to an advantageous embodiment of the invention, the reflector element is made of metal. This enables the use of lamps radiating high heat energy and a simple design.

According to a further advantageous embodiment of the invention, the reflector element is made of press-formed aluminum.

As a result, conventional manufacturing methods and materials can be employed.

According to a further advantageous embodiment of the invention, the reflector element comprises a base body configured rotation-symmetrical about the center longitudinal axis thereof with respect to the basic shape, wherein the base body is cut off, sawed off or severed in another manner in the region of the light emission opening along a plane at an incline to the center longitudinal axis. It is known from the prior art to produce reflector elements having a substantially rotation-symmetrical shape by pressing circular aluminum blanks. In this respect, reference shall be made by way of example to the post-published German patent applications DE 10 2007 035 396 and DE 10 2007 035 528, which are both by the applicant, and the content of which is hereby included in the content of the present patent application, also for the purpose of referring to individual or several characteristics.

By producing a reflector element having a rotation-symmetrical base body, the production of the reflector element can be kept relatively simple. Severing the base body in the region of the light emission opening thereof along a plane that extends at an incline to the center longitudinal axis creates a

light fixture with a very small installation depth, which is to say a compact design. In order to achieve the desired lighting characteristic, irrelevant reflector sections can be severed and discarded.

A reflector that is produced according to this advantageous embodiment of the invention allows the segments, comprising different, individually shaped reflection surfaces, to be disposed arbitrarily along the inside of the reflector element.

The segments may be provided in a non-rotation symmetrical manner, while the base body is configured to be substantially rotation-symmetrical about the center longitudinal axis thereof. While the outside of the reflector element is configured rotation-symmetrical prior to severing the reflector element along the cutting plane, the reflective inside is preferably provided with differently arched segments in a non-rotation symmetrical manner.

According to a further advantageous embodiment of the invention, the spread lens plate is disposed along the cutting plane. As a result, a particularly compact shape of the light fixture becomes possible.

According to a further advantageous embodiment of the invention, at least several of the segments are each formed by a section of a cylinder, particularly a circular cylindrical body. The use of cylindrical segments advantageously enables the desired radiation characteristic of the light fixture to be achieved along a first direction. All segments on the inside of the reflector

element are preferably formed by cylindrical bodies, particularly circular cylindrical bodies.

The center longitudinal axis of the cylinder, referred to as the cylinder axis, is preferably oriented substantially parallel to the center longitudinal axis of the reflector or inclined in relation to the same at an angle of less than 45°. The cylinder axis is the axis of a cylindrical segment, which is the center longitudinal axis of the corresponding circular cylinder that provides the cylinder surface. The inclines of the cylinder axes may vary with the distance of the cylinder from the apex region of the reflector. By varying the inclinations of the center lines of the cylinders, the desired light radiation characteristic can be implemented in a particularly optimized manner.

Furthermore, tangents can be placed on the outside of the reflector in a connecting region of a cylindrical segment to the reflector. Between the respective tangent and cylinder axis of the associated segment, an angle of deviation is located. This angle of deviation can advantageously vary with the varying distance of the segment from the apex region. For this purpose, reference is made to the afore-mentioned German patent application DE 10 2007 035 396 by the applicant, which describes in detail the advantages of such a configuration of segments, and the content of which is hereby also included in the content of the present patent application, also for the purpose of referring to individual characteristics.

According to a further advantageous embodiment of the invention, the inclines of the cylinder axes of the cylindrical

segments, particularly along an angle of circumference region, are advantageously selected such that the light beams impinging upon the cylindrical segments intersect in a focal point when using a punctiform light source. This enables, for example, the imitation of a reflector having an elliptic cross-section, even if the reflector element uses a base body having a contour with a parabolic cross-section. In this way, elliptic reflectors can be imitated, while enabling light fixtures with very small installation depths at the same time.

According to a further advantageous embodiment of the invention, the focal point is located outside of the light emission opening of the reflector element. Furthermore, the focal point is advantageously located close to the light emission opening of the light fixture. This enables a particularly optimized light distribution and a particularly compact light fixture.

According to a further advantageous embodiment of the invention, the cylinder axes of a plurality of cylinders, particularly of a partial region of the inside of the reflector element, with the region being explained in more detail

hereinafter, having the same distances to the apex region of the reflector have the same inclinations to the center longitudinal axis of the reflector element. This enables particularly uniform illumination of the building surface.

According to a further advantageous embodiment of the invention, the inside surface of the reflector element is provided with segments along the entire circumference. This enables a

particularly optimized adjustment of the light fixture to the desired radiation characteristics.

According to a further advantageous embodiment of the invention, the inside surface of the reflector element is divided into at least two partial regions. Segments of different types, for example segments of a first type and segments of a second type, can be disposed in different partial regions. Segments of a first type may imitate the reflection behavior of a reflector having a parabolic cross-section, and segments of a second type may imitate the reflection behavior of a reflector having an elliptic cross-section. In the different partial regions, it is also possible that segments of different sizes, elongated differently in the axial direction, and differently arched or different bent segments may be provided. It is also possible that the number of columns and the number of rows of the segments vary in the different partial regions. A first partial region preferably extends across an angle of circumference of 180° and a second partial region across an angle of circumference of 180°. In a different embodiment of the invention, also more than two partial regions having different angles of circumference may be provided.

The segments may be disposed along rows extending in a circular fashion about the center longitudinal axis of the reflector and along columns extending transversely to the rows.

In one of the two partial regions, the number of rows of segments is preferably higher, preferably twice as high as the rows of segments in the other partial region. Furthermore, in the partial region with the higher number of rows,

the segments of two adjoining segments in the axial direction, respectively, are preferably disposed offset in relation to one another in the circumferential direction such that a brick wall-like structure is obtained.

Furthermore, due to a severing of the produced reflector element along a cutting plane obliquely to the center longitudinal axis of the reflector element, the number of segments in a column preferably varies as a function of the angle of circumference of the column.

According to a further advantageous embodiment of the invention, the first partial region and the second partial region are separated by a boundary plane. In the first partial region preferably segments are provided which primarily imitate a reflection behavior of a reflector having a parabolic cross-section, and in the second partial region segments are provided which primarily imitate a reflection behavior of a reflector having an elliptic cross-section.

The boundary plane and the cutting plane meet in a straight line. This straight line is disposed perpendicular to the center longitudinal axis of the reflector element.

The largest cross-sectional surface of the reflector element is a cut through the reflector element along the center longitudinal axis thereof, the cut being made perpendicular to the boundary plane. The largest cross-sectional surface of the reflector element is hence a cross-section of the reflector element, comprising the segment farthest removed from the apex

region and the segment disposed 180° opposite thereof at the free edge of the reflector element.

When viewing a largest cross-sectional surface of the reflector element, a plurality of segments of a first type are provided on the first side of the center longitudinal axis of the reflector element and a plurality of segments of the second type are provided on the other, opposite side of the center longitudinal

axis of the reflector element. This observation illustrates that the reflector element comprises two essential, characteristic regions with different features regarding the light beam and/or reflection characteristic. The region of the reflector element that is removed from the building surface to be illuminated comprises a plurality of segments which imitate the reflector behavior of an elliptic reflector, and the segments of the reflector element disposed on the side of the center longitudinal axis that is close to the building surface to be reflected imitate the reflection behavior of a reflector having a parabolic cross-section.

According to a further advantageous embodiment of the invention, when viewing a cross-sectional surface that is disposed perpendicular to the largest cross-sectional surface, a symmetrical configuration of the reflector element in relation to the center longitudinal axis is apparent. The observation in this embodiment of the invention is thus made along a plane that extends parallel to the boundary plane. When observing such cross-sectional surfaces, the reflector element appears to have a completely symmetrical configuration. This embodiment is particularly

advantageous in order to achieve especially uniform illumination of the building surface.

According to a further advantageous embodiment of the invention, the spread lens plate ensures the spreading of the light in a direction transversely to the largest cross-sectional surface.

Spreading is thus performed in a direction along the boundary plane.

The spread lens plate comprises a plurality of cylindrical lenses, for example formed by a plurality of ribs extending transversely to the boundary plane, which is to say along a direction parallel to the largest cross-sectional surface. The cylindrical lenses preferably extend in a direction along the cutting plane.

Furthermore, the light fixture is advantageously configured as a wallwasher.

This enables a particularly uniform illumination of the wall.

Furthermore, the light fixture is advantageously configured as a recessed light fixture or as a spotlight to be installed on the ceiling. This enables a uniform illumination even of regions on the vertical wall close to the ceiling.

According to a further advantageous embodiment of the invention, a partial region of the reflector for imitating a light distribution of a parabolic reflector is disposed relative to the light source such that the lighting portions reflected thereon primarily illuminate a region of the light fixture removed from the light fixture [sic]. Similarly, advantageously the regions of the

reflector imitating the light distribution of a reflector having an elliptic cross-section are disposed such in relation to the light source that the light beam portions reflected therein primarily illuminate a region of the building surface close to the light fixture. In this way, even very high vertical building surfaces can be illuminated.

The invention furthermore relates to a method for producing a reflector element made of a starting material workpiece according to claim 59.

Methods for producing reflector elements that are configured rotation- symmetrical about the center longitudinal axis thereof are known.

It is the object of the invention to further develop a known method for producing a reflector element such that a reflector element can be produced which allows the development of light fixtures in compact designs.

The invention achieves this object with the characteristics of claim 59.

Compared to known methods for producing a reflector element, it is provided according to the invention to sever a section of the reflector element along a separation plane. The separation plane is disposed at an incline to a

center longitudinal axis of the reflector element. At an incline shall mean that severing occurs along an acute angle to the center longitudinal plane, preferably along an angle ranging between 30° and 50°. Furthermore, with respect to the angle of the plane, the inclination of the separation or cutting plane'

preferably corresponds to the desired shielding angle of the light fixture in the installed state to be provided by the dark light reflector.

The invention furthermore relates to a light fixture according to claim 60.

It is the object of the present invention to further develop a known light fixture by the applicant, the light fixture having been described above and known by prior public use, such that greater variability of the illumination of building surfaces is possible.

The invention achieves this object with the characteristics of claim 60.

The principle of the invention is essentially to provide a first reflector element for the light fixture, wherein a plurality of segments comprising surfaces that are arched toward the inside are disposed on the inside of the element. In addition, a second reflector element is provided, which can replace the first reflector element. The second reflector element has outer dimensions that are identical or very similar to those of the first reflector element. This means that the basic shape of the second reflector element corresponds to the basic shape of the first reflector element. Also the second reflector element is cut or severed obliquely or at an incline to the center longitudinal axis, or comprises an oval opening, the border of which is oriented along a plane that is disposed at an incline to the center longitudinal axis of the reflector element. Also the oval light emission opening has identical dimensions in both reflector elements, so

that the same spread lens plate can be used for the first or second reflector element.

Compared to the first reflector element, however, the second reflector

element is provided with a different number or type or configuration or curvature of segments. For example, the radii of curvature of the segments can be configured differently, or a different orientation of the cylinder axes of cylindrically configured segments may be provided. The type or configuration of the segments is varied as desired in order to achieve a defined light radiation characteristic. This light radiation characteristic, which is produced by the second reflector element, differs from the light radiation characteristic which the first reflector element can produce using the same light source.

While with the aid of the spread lens plate, for example, uniform illumination of the wall across a large vertical height can be produced with the first reflector element, when replacing the first reflector element with the second reflector element, for example, a focus area, which is to say a lighting focus area, of the building surface to be illuminated in a certain location can be achieved.

The second reflector element has the same dimensions as the first reflector element, so that it can be installed and attached in the existing light fixture housing with the same fastening means and using the same spread lens plate. This enables a modular light fixture design and the use of a second reflector element instead of an existing first reflector element provided at

the point of use. By replacing a first reflector element with a second reflector element, a desired, completely different light radiation characteristic can be produced.

Further advantages of the invention are disclosed in the dependent claims, which have not been cited, as well as the description provided hereinafter of the exemplary embodiment illustrated in the drawings, wherein:

FIG. 1 is a first example of the light fixture according to the invention in a very schematic illustration, comprising a tub-shaped base body, which is provided on the bottom and illuminates a housing wall,

FIG. 2 is a schematic lateral cross-sectional view of the light fixture according to FIG. 1, approximately along the intersecting line II-II in FIG. 1,

FIG. 3 is a schematic illustration of the light fixture according to FIG. 2, illustrating the base body and configuration of the light source, approximately along the view intersecting line III-III in FIG. 2,

FIG. 4 is a schematic view, in an illustration according to FIG. 1, of a building surface to be illuminated in a first illumination situation,

FIG. 5 is the depiction, in an illustration according to FIG. 4, of a second, different illumination situation,

FIG. 6 is a schematic illustration, similar to the illustration according to FIG. 2, of a further example of a light fixture according to the invention configured as a recessed light fixture,

FIG. 7 is the reflector element of the light fixture according to FIG. 6 in a perspective separate illustration, the element being provided with a plurality of segments on the inside thereof,

FIG. 8 is a schematic illustration equivalent to the illustration according to FIG. 1, an installation situation for illuminating a building surface, the light fixture according to FIG. 2 being mounted on the ceiling,

FIG. 9 is a separate illustration of a spread lens plate, which is used for the light fixture according to FIG. 6, in a schematic illustration not true to scale, approximately along the viewing line IX-IX in FIG. 6, wherein a dark-light reflector section of the light fixture according to FIG. 6 has been left out for clarity reasons,

FIG. 10 is the lens plate in a schematic, partially cut illustration, approximately along intersecting line X-X in FIG. 9,

FIG. 11 is a diagram of the luminous intensity distribution obtained when using a light fixture according to FIG. 6 in an installation situation according to FIG. 8 on the wall 15 to be illuminated if the spread lens plate provided in the light fixture according to FIG. 6 is removed,

FIG. 12 is an illustration according to FIG. 11 of the luminous intensity distribution on the wall 15 to be illuminated when using a light fixture according to FIG. 6 with a spread lens plate,

FIG. 13 is the reflector element according to FIG. 7 in an inside view, approximately according to the viewing arrow XIII in FIG. 7,

FIG. 14 is a schematic cross-sectional view of the reflector element according to FIG. 13, approximately along the intersecting line VI-VI, wherein the illustration according to FIG. 14 shows the reflector element directly after its completion, before performing the cutting or severing step, while the reflector element according to FIG. 13 is the reflector element after completion, which is to say after performing the severing step and after severing the piece 75,

FIG. 15 is an enlarged detailed view of a boundary region of the reflector element from FIG. 14 according to the partial circle XV from FIG. 14,

FIG. 16 is an illustration comparable to FIG. 14 of the reflector element in a schematic view, showing the course of the cylinder axes, and

FIG. 17 is a line illustration in a clearly enlarged view of a region of the inside surface of the reflector element comprising segments, the region being marked as partial circle XVIII in FIG. 13.

A first exemplary embodiment of the inventive light fixture is denoted overall

in the figures with the reference numeral 10. With respect to the description of the figures below, it should be noted that insofar as different parts or elements are denoted in the figures, these are labeled with the same reference numerals, in

part by adding lower case letters. This also applies to different exemplary embodiments of the invention.

According to FIG. 1, the inventive light fixture 10 is provided with a base body 11 and a light source 12 and configured as an in-ground light fixture. For this purpose, it is installed in the floor 13 of a building room or an exterior space and disposed substantially flush with the top of the floor surface 13, as will be apparent below from FIG. 2.

In the example according to FIGS. 1 to 3, the light fixture is configured as an axially elongated light fixture comprising a substantially tub-shaped base body 11.

FIG. 1 illustrates that the light fixture is installed in the floor in the installation situation according to FIG. 1 and serves the illumination of the building wall 15. Different arrows 18, 19, and 20 are intended to illustrate that different vertical surface regions of the building surface 15 can be illuminated. Alternatively, the light fixture 10 however can also be ceiling-mounted, which is to say it can be installed in or on the ceiling wall 14, and uniformly illuminate the building surface 15.

Finally, it is also possible that the building light fixture 10 is provided on the lateral wall 16 or 17 in order to illuminate the building surface 15. It is likewise conceivable that the light fixture 10 configured as an in-ground light fixture in an installation situation according to FIG. 1 does not illuminate the building wall 15, but the building wall 16 or the building wall 17.

In FIG. 1, the spatial coordinate system is illustrated by the arrows x, y, and z. The double arrow x describes the axial

extension of the light fixture and the double arrow  $z$  a direction transversely to the axial extension, specifically the vertical heights. The double arrow  $y$ , which is only indicated in FIG. 1 with

reference to the floor surface 13, describes a further lateral extension to the axial direction  $x$ , specifically the spatial depth.

It is best apparent from FIG. 2 that the base body 11 is substantially configured in a cup shape. The light source 12 is disposed on the inside space 31 of the base body 11. It is configured as an axially elongated light source, for example as an axially elongated HID lamp. The base body 11 comprises a wall section 21 with an elliptic cross-section. The elliptic wall section 21 is associated with a focal point  $F$ , wherein the light source 12 is disposed relative to the elliptic wall section 21 such that the center longitudinal axis  $M$  thereof (FIG. 3) is disposed along the focal point axis  $F$ . The beams emitted by the light source 12 and reflected on the elliptic reflector surface 21 therefore meet in a second focal point  $B$ , which is located in the region of a cover glass 25 of the light fixture. The indicated light beam 29c, which is a direct lighting portion, likewise extends through the second focal point  $B$

The base body 11 furthermore comprises a second reflector wall section 22, which has a parabolic cross-section. The wall section 22 is disposed such that the focal point of the parabola coincides with the focal point  $F$  of the elliptic wall section 21.

In an embodiment of the invention which is not illustrated, the wall section of the reflector having a parabolic cross-section is disposed such that the focal point of the parabolic wall section is provided at a distance from the focal point of the elliptic wall section 21. The light source can then be provided either on the focal point of the elliptic wall section or on the focal point of the parabolic wall section or between the two focal points or in the vicinity of the two focal points.

Starting from the light source 12, direct lighting portions, indicated by the beams 29a, 29b, and 29 c, and indirect lighting portions, indicated by the beams 30a, 30b, and 30c, reach a spread lens plate 23. The indirect lighting portions,

which starting from the light source 12 are reflected on the parabolic wall section 22 before impinging upon the spread lens plate 23, all reach the lens plate along a parallel main radiation direction H, illustrated by the light beam 30a.

The spread lens plate can be, for example, made of clear glass or slightly matt-finished glass, which is provided with cylindrical lenses. In the example according to FIG. 2, the lens plate has a substantially rectangular basic shape, which corresponds approximately to the contour K of the base body 11 according to FIG. 3. The spread lens plate can be embossed glass or sheet glass.

The cross-section of the lens plate is indicated schematically in FIG. 10 in accordance with the intersecting line X-X from FIG. 2. The spread lens plate 23 can accordingly comprise an inside 32 and an outside 33. On the inside 32 of the lens plate

23, a plurality of cylindrical lenses 34a, 34b, and 34c are provided. A beam of rays, which according to FIG. 10 is illustrated as being parallel, is widened under a divergence angle  $w$  as a function of the focal length of the cylindrical lenses.

Comparable widening of course also occurs when the light beam occurring on the inside 32 of the spread lens plate does not impinge entirely parallel, as is the case in the example of the light fixture according to FIGS. 1 to 3, but instead arriving from different directions.

The cylindrical lenses 34a, 34b, 34c have a constant cross-section along a direction transverse to the paper plane according to FIG. 10. Each cylindrical lens 34a, 34b, 34c has an elongated configuration. The longitudinal extension of the cylindrical lenses is then disposed transversely to the axial extension  $x$  of the tub-shaped base body 11 and transversely to the axial longitudinal extension of the light source 12.

The cylindrical lenses may have an axial extension which corresponds to

the axial extension of the spread lens plate 23. In an alternative embodiment of a spread lens plate 23, which is not shown, the cylindrical lenses can also be formed by axially short sections of cylindrical lenses.

While the lenses in the example according to FIG. 10 are configured as convex lenses on the inside 32, alternatively also concave lenses can be used, achieving the same lighting effect.

It is apparent from FIG. 2 that the arrangement of the elliptic wall section 21 combined with the arrangement of the

parabolic wall section 22 on the vertical wall 15 generates a luminous intensity distribution that illuminates the building surface 15 in the desired manner. The beam of rays reflected by the parabolic reflector surface 22 and radiating parallel is deflected relatively far upward and in this manner can illuminate a building surface region located relatively far up on the vertical building wall 15. This light beam portion is illustrated by the arrow 20 in FIG. 1. The parabolic reflector section 22 thus substantially serves to direct indirect lighting portions up high.

In this way, for example, a particularly high building wall, which is to say a wall extending high in the z-direction, can be illuminated all the way to the regions up high. If a light fixture 10 according to FIG. 2 is mounted in the ceiling, accordingly a region relatively far down on a vertical building surface can be illuminated.

In general, it can be noted that by arranging the parabolic wall section 22 a building surface region which is far removed from the light fixture 10 can be illuminated.

At the same time, the arrangement of the elliptic wall section 21 enables the illumination of a building surface region close to the light fixture 10, in relation to FIG. 1 a central region, which is indicated for example by the arrow 19 in FIG. 1. Finally, the direct lighting portions, which are indicated by the beams 29a, 29b in FIG. 2 or by the arrow 18 in FIG. 1, can illuminate lower building surface

regions, which is to say regions close to the light fixture.

It shall be noted that the observations above are illustrated in a very simplified manner for reasons of clarity. Overall, however, it can be stated that by using and mixing direct lighting portions and indirect lighting portions, wherein the indirect lighting portions are reflected on elliptically shaped reflector sections and on parabolic reflector sections, overall a particularly uniform luminous intensity distribution can be achieved.

In this way, both building surface regions close to the light fixture and also building surface regions removed from the light fixture can be homogeneously illuminated.

To further illustrate the principle according to the invention, reference is made to FIGS. 4 and 5, which substantially correspond to the illustration in FIG. 1.

The hatched region indicated on the vertical building wall 15 is intended to represent a region to be illuminated by the light fixture 10. As is apparent from FIG. 4, the entire vertical building wall 15 is supposed to be illuminated substantially uniformly. Such a lighting situation is desired, for example, when paintings 35a, 35b in a museum are supposed to be illuminated.

By contrast, FIG. 5 shows an illumination situation on a vertical wall 15, wherein only an upper region of the wall is to be illuminated, for example because in the upper region of the vertical wall goods 36a, 36b are provided, for example on a shelf 37, which are supposed to be highlighted. Both illumination situations according to FIGS. 4 and 5 can be achieved using a light

fixture 10, wherein the light fixture to be used in each case comprises different reflector sections 21, 22.

FIG. 2 furthermore shows that in the light radiation direction, for example

in the main radiation direction H, a dark-light reflector section 26 is provided behind the spread lens plate 23. The dark-light reflector 26 provides shielding to an observer located approximately in the spatial angle region P at a shielding angle  $\alpha$ .

The shielding angle  $\alpha$  can be  $40^\circ$ , for example. The dark-light reflector 26 ensures in a known manner that an observer located in the region P does not see any light beams reflected by the dark-light reflector 26.

Also for production reasons, it is provided in the example according to FIG. 2, that a planar intermediate element 27 connects the elliptic wall section 21 to the parabolic wall section 22. The intermediate element preferably performs only a small or no lighting function and serves particularly the mechanical fastening of the two cylindrical wall sections 21 and 22 to each other, particularly to increase the mechanical stability. The intermediate section [sic] 27 can also be made of a highly reflective material and may, under certain circumstances, contribute to the conductance of light.

Furthermore, the example according to FIG. 2 indicates a dimming element 28 provided in the light radiation direction of the light source 12 in front of the parabolic wall section 22. The dimming element 28 dims a small section of the parabolic wall section and can ensure that the light is directed as desired. In

the example according to FIG. 2, the indicated light beam 30a extends through the dimming element 28. This is supposed to illustrate that the dimming element 28 may also be eliminated in one embodiment of the invention. If the dimming element 28 is disposed in the light path, the element is preferably configured opaque.

The spread lens plate 23 is disposed transversely to the main radiation direction H of the light fixture 10. This means that the main radiation direction of the light fixture, the direction being denoted with H, is provided substantially normal to the substantially planar spread lens plate. The spread lens plate is inclined, particularly at a shielding angle  $\alpha$  of 40°, at an incline to the vertical building

surface 15 to be illuminated. The cover plate 25 of the light fixture is provided parallel to the floor surface 13 and is made particularly of clear glass. If the light fixture is configured as an in-ground light fixture in accordance with FIG. 2, the cover plate 25 is aligned particularly flush with the floor surface and in this way eliminates any edge that could be a tripping hazard. The cover plate can preferably also be stepped on.

If the light fixture shown in FIG. 2 is configured as a recessed light fixture or as a light fixture to be installed on the ceiling, the cover plate 25 may be completely foregone under certain circumstances, so that the light emission opening 38 of the light fixture is completely open.

Based on FIGS. 6 to 17, a further example of an inventive light fixture 40 will be described hereinafter:

FIG. 6 shows an inventive light fixture 40, which is configured as a recessed light fixture for installation in a ceiling 14. The light fixture 40 is to be used to illuminate a vertical wall 15, so that in agreement with FIG. 1 it is the same building surface 15 to be illuminated, however unlike in FIG. 1 it is a light fixture 40 installed on the ceiling.

It shall be noted that the inventive light fixture 40 can also be configured as a surface-mounted ceiling light fixture or as a spotlight, which is to say particularly that it can be installed displaceably on a spot carrier, for example mounted on a track.

The light fixture 40 according to FIG. 6 comprises a reflector 41, a lamp 42, a spread lens plate 43 and a dark-light reflector section 46. In the region of the light emission opening 38 of the light fixture 40 optionally also a cover glass may be provided. With an installation on the ceiling, however, the cover glass is usually not necessary.

The reflector element 41 is shown in FIG. 7 alone in a perspective oblique view and in FIG. 13 alone in a top view, approximately along the viewing direction XIII from FIG. 7. The reflector element comprises an inside 69, which is provided with a plurality of arched segments. The geometrical configuration of these segments will be explained below with reference to FIGS. 14 to 17.

The basic shape of the reflector element 41 is substantially parabolic in its cross-section. This parabolic basic

shape is apparent when viewing the cross- section of the reflector element 41 according to FIG. 6 from the left boundary region 46 according to FIG. 6 across the center apex region 44 to the right boundary region 45 according to FIG. 6. The focal point associated with the parabolic base body is denoted with F in FIG. 6. In this context, however, it shall be noted that FIG. 6 shows a reflector element 41 on a completely installed light fixture 40, wherein a reflector element 41 having originally a substantially rotation-symmetrical basic shape has already been severed or cut off.

The manufacturing method will also be described in detail hereinafter.

A lamp 42 is provided in or close to the focal point F of the parabolic basic shape of the reflector 41. In the embodiment according to FIG. 6, the lamp 42 is a metal halide lamp. Such a metal vapor lamp has a very small, almost punctiformly shining volume, so that in this context it is also referred to as a punctiform light source.

The lamp 42 is fastened to a light fixture housing in a manner which is not shown. Also a reflector element 41 can also be fastened directly to the light fixture housing, optionally by using fastening elements cooperating with a lamp base 70. The light fixture housing is not shown in FIG. 6 for clarity reasons. The electrical feed lines as well as optional electronic control lines for a ballast for the lamp 42 have also been eliminated from FIG. 6 for simplicity reasons.

The reflector element 41 has a basic shape that is substantially rotation-symmetrical about the center longitudinal axis 43 thereof. FIG. 14 shows the reflector element 41 according to FIG. 6 alone, directly after the manufacturing process. It is apparent to the observer that the reflector element 41 originally extends from the left boundary region 46a according to FIG. 14 via the apex region 44 to the right boundary region 45 according to FIG. 14. The reflector element 41 has been cut off or severed along the cutting plane 53 after the manufacturing process. According to FIG. 6, the cutting plane 53 extends in the example particularly at an angle  $\gamma_1$  of approximately  $70^\circ$  relative to the center longitudinal axis 43 of the reflector 41.

Along the cutting plane 53, a spread lens plate 23 is provided on the light fixture 40 according to FIG. 6. The spread lens plate 23 corresponds to the spread lens plate discussed above for the example according to FIG. 2 in terms of the function thereof. Since as a result of the severing of the reflector element 41, which originally was configured substantially rotation-symmetrical about the center longitudinal axis 43 in terms of the basic shape, now an oval light emission opening 24 exists on the reflector element 41, as is also apparent from the view of FIG. 9 in an exaggerated illustration, the spread lens plate 23 has an oval shape. The inside view according to FIG. 13 also shows the oval contour of the light emission opening 24 in a true-to-scale illustration.

As is apparent best from the inside view of the reflector element 41 according to FIG. 13, the entire inside of the reflector

element is divided into two partial regions 72 and 73. The two partial regions 72 and 73 are separated from each other along a boundary plane 51.

The segments of the partial region 72 primarily serve the imitation of the reflection behavior of a reflector having an elliptic cross-section. The segments disposed in the partial region 73 of the reflector 41 substantially serve the imitation of the reflection behavior of a reflector having a parabolic cross-section.

In FIGS. 14 and 16, only the segments of the first partial region 72 are indicated and the segments of the second partial region 73 have been left out for clarity reasons.

As is apparent from a view of FIG. 14, a plurality of segments extend from the apex region 44 to the right boundary 45 of the reflector element 41 according to FIG. 14, wherein only the segments close to the boundary 59a, 59b, 59c, 59d, 59e are marked.

The indicated light beams illustrate that the light beams starting from the light source in the focal point F are reflected on the segments and come together in a second focal point B located outside of the light emission opening 24 of the reflector element 41.

The lighting portions that start from the focal point F and do not impinge upon segments of the second partial region 73, the segments not being shown, can leave the reflector 41 as parallel beams.

FIG. 15 indicates that between every two segments of the first partial region 72 adjoining each other in the axial direction

along the center longitudinal axis 43, for example between the adjoining segments 59b and 59c, also radial undercuts 60c may be provided. While the dotted lines in FIG. 15 indicate straight lines extending parallel to the center longitudinal axis 43 of the reflector element, the open spaces denoted with 60c, 60d, and 60e illustrate that radial undercuts may be provided between two adjoining segments 59b, 59c, 59d, 59e, respectively. Such radial undercuts are described in detail in the above-mentioned post-published German patent application DE 10 2007 035 528 by the applicant, so that the application is hereby included by reference for the purpose of avoiding repetitions to explanations provided there, also for the purpose of including individual characteristics.

It shall be noted that the provision of such radial undercuts is

advantageous for the inventive light fixture, but not absolutely essential.

FIG. 15 furthermore illustrates that the surfaces of the segments 59b, 59c, 59d, 59e contributing to reflection are denoted with the reference numerals 61c, 61d, 61e. These cylindrical surfaces form the surfaces of this reflector section that in fact provide the lighting effect. On the other hand, the frontal surfaces facing the light emission opening 24, for example the surfaces 62d and 62e, have no lighting influence whatsoever on the reflection behavior of the reflector 41.

For simplicity reasons these frontal surfaces are denoted with reference numeral 62 in FIG. 13 and are shown as lightly

shaded regions. These shaded regions extend in a circular fashion about the center longitudinal axis 43, however they vary in their contours.

A comparison of the two partial regions 72 and 73 illustrates that in the partial regions completely different geometrical structures are apparent, wherein it is particularly evident that in the first partial region 72 larger surface portions on frontal surfaces are provided than in the partial region 73.

FIG. 16 illustrates a further aspect of an advantageous embodiment of the inventive light fixture: In this figure, the segments 59aa, 59ab, 59ac, 59ad, 59ae, 59af, 59ag, 59ah, 59ai, 59aj, 59ak, 59al, 59am disposed between the apex region 44 and the free boundary region 45 are shown schematically. FIG. 16 illustrates that in each application area of a segment a tangent can be applied to the outside 74 of the reflector element 41. The tangents are denoted with 68ab, 68af, 68ai, and 68am in FIG. 16. Tangent 68ab is applied to the outside 74 of the reflector element 41 in the region of the connection of segment 59ab. Segment 59ab is configured as a cylindrical segment. FIG. 17 illustrates, by way of example based on a segment 59k, that each segment is formed by a cylindrical base body having a basic radius  $r$  and the height  $I$ . The arched cylindrical surface 61 k of this segment provides the actual reflection surface of the respective

segment. The cylinder axis for the segment 59k is denoted with 66k in FIG. 17.

The cylinder axes of the segments 59ab, 59af, 59ai, and 59am are denoted in FIG. 16 with 66ab, 66af, 66ai, and 66am.

Between the respective cylinder axis and the respective tangent, an angle of deviation 67ab, 67af, 67ai, and 67am is provided. This angle of deviation can vary as the distance of the respective segment from the apex region varies 44.

In this way, it is possible to generate a reflection behavior as that indicated in FIG. 14 and FIG. 6. The first partial region 72 of the reflector element 41 thus primarily serves the generation of the reflection behavior of a reflector having an elliptic cross-section, so that the light beams come together in a focal point B. In FIG. 6, the light beams are denoted by way of example with 47a, 47b, 47c, and 47d and meet in a focal point B, which is located approximately in the region of a light emission opening 38 of the light fixture.

The light beams 48a, 48b, 48c emitted by the light source 42 according to FIG. 6 exit the light fixture 40 in a substantially parallel manner. If the light fixture 40 is installed on a ceiling, as is indicated for example in FIG. 6, the light beams reflected on the first region 72 primarily serve the illumination of a region of the building surface 15 to be illuminated that is close to the light fixture, while the light beams reflected on the second partial region 73 primarily serve the illumination of a region of the building surface 15 that is removed from the light fixture.

In this context it shall be noted that direct lighting portions are not shown in FIG. 6, but instead have been left out for clarity reasons.

It shall also be noted that FIGS. 14 to 17 should be understood to serve only as examples and are provided for explaining the invention. According to the invention, also in the respective partial region 73 preferably a plurality of segments are provided, which are formed by cylindrical bodies, as is shown for example in FIGS. 7 and 13.

FIG. 13 illustrates that the segments are provided along rows disposed in a circular fashion about the center longitudinal axis 43. The segments 63a, 63b, and 63c according to FIG. 13 are thus part of a common row. Columns extend transversely thereto. The segments 64a, 64b, and 64c according to FIG. 13 are part of a common column.

FIG. 13 furthermore illustrates that the partial region 72 comprises twice as many rows as the partial region 73. FIG. 13 also shows that each segment of two adjoining rows of segments in the partial region 72 is disposed offset on the circumference by approximately half a column width.

FIG. 13 furthermore illustrates that the boundary plane 51 is provided substantially perpendicularly to the largest cross-sectional surface 52. FIG. 6 accordingly shows a view of the reflector element 41 along the largest cross-sectional surface, which is to say approximately in a view direction of the intersecting line VI-VI in FIG. 13.

FIG. 8 illustrates the principle of the light fixture 40 according to the invention: In the absence of a spread lens plate 23, it is possible through the inventive arrangement of segments on the inside of the reflector element 41 to achieve a light

distribution having, for example, a substantially oval contour, which is indicated by the contour line 57 in FIG. 8, for example. In order to achieve a wide, uniform light distribution, a contour as that shown in dotted lines 58 in FIG. 8 can be achieved with the aid of the spread lens plate 23. It should be noted that the essential aspect is not to achieve a certain contour, but to illuminate the building surface to be illuminated particularly uniformly across the surface.

The diagrams according to FIGS. 11 and 12, which show the luminous

intensity distributions in lines of equal luminous intensities, are better suited than the provision of contours. FIG. 11 accordingly shows a contour 57 according to FIG. 8 of the luminous intensity distribution on a wall 15 produced by means of a light fixture 40, wherein the spread lens plate 23 was eliminated.

FIG. 12 shows the luminous intensity distribution on the same wall with the aid of the spread lens plate 23. It is apparent from FIG. 12 that the luminous intensity distribution is clearly broader and that the uniformity with respect to the luminous intensity distribution from FIG. 6 without the spread lens plate is greater.

It should be noted that FIGS. 9 and 10 show a spread lens plate 23, wherein in principle a spread lens plate 23 can be used as that described above in the example according to FIGS. 1 to 5. It is essential for the invention that the spread lens plate provides lenses, which ensure a spreading of the lighting portions to help produce a more uniform illumination of the building wall. Preferably cylindrical lenses are disposed on at least one of the

two surfaces of the spread lens plate 23. FIG. 10 illustrates such cylindrical lenses on the inside, wherein it should be noted that the lenses can also be provided on the outside or alternatively on both sides.

The axial orientation of the cylindrical lenses 34a, 34b, and 34c is such that they are oriented parallel to the intersecting line VI-VI from FIG. 13. In this way, spreading of the light along the line denoted with reference numeral 51 in FIG. 13 is achieved.

FIG. 8 illustrates that the vertical building wall 15 to be illuminated can be illuminated with the beams 54, 55, and 56 along the desired vertical height, the beams being intended to symbolize the appropriate lighting portions. In agreement with the illustration according to FIGS. 4 and 5, the inventive light fixture 40, however, can also be used to illuminate arbitrary regions of the building surface 15 to be illuminated.

It should be noted that the inventive light fixture 40 preferably comprises a reflector element 41, which is provided on the inside thereof entirely with segments, preferably entirely with cylindrical segments. The teaching according to the invention, however, also includes such light fixtures whose reflector element 41 on the inside 69 thereof is provided with cylindrical segments only along an angle of circumference region about the center longitudinal axis 43, wherein the remaining regions of the circumferential inside of the reflector element 41 can be provided with differently configured segments or can be left smooth.

Finally, the inventive light fixture also comprises a reflector element which is provided on the inside thereof with

spherically or aspherically arched segments. A key element of the invention in the subject matter of claim 20 is a combination of a spread lens plate with a faceted reflector divided into segments, wherein an individual configuration of the reflection surface with the plurality of segments produces a radiation characteristic along a first direction and the use of a spread lens plate produces appropriate spreading in another direction.

With respect to a production of a light fixture according to FIG. 6, it should be noted that the reflector element 41 is preferably made of press-formed aluminum. For this purpose, a circular aluminum blank can be used to produce, by pressing against a rotating male mold, a cup-shaped reflector element that is substantially rotation-symmetrical in its basic shape. The male mold, which is not shown, is provided with appropriate contours on the outside, wherein these outside contours can be embossed or pressed into the inside of the reflector element 41. Removal of the mold from the reflector element is possible in the axial direction. When providing undercuts, as is indicated in FIG. 15, preferably also a multi-part tools can be used, which is described in the aforementioned post-published patent application by the applicant.

After removing the mold from the reflector element, the element can be severed along the cutting plane 53. Starting from FIG. 14, severing by means of

sawing or cutting, for example, is performed such that a cutting tool is displaced relative to the fixed reflector element 41 along the plane 53. The region between the original free

boundary 46a and the new, decisive boundary region 46 after severing the separating piece 75, which is to say the separating piece 75, is removed and is scrapped.

The remaining reflector element 41 comprising the now oval light emission opening 24 can be installed in the light fixture 40 and enables a particularly compact design. In a particularly advantageous embodiment, the center longitudinal axis 43 of the reflector element 41 is disposed at an incline to the ceiling 14 in the installed state of the light fixture 40.

FIG. 6 furthermore shows a dark-light reflector section 26, which enables shielding at a shielding angle of approximately 40c.'.

With respect to the principle of the dark-light reflector technology, reference is made to published prior art by the applicant and the knowledge of the person skilled in the art. The dark-light reflector section 26 makes it possible to prevent glare for an observer located in the spatial angular region P of the angular degree  $\alpha$  by light beams reflected on the reflector section 26.

For a better understanding of the geometrical design of the reflector, it should be noted that the boundary plane 51 extends between the partial regions 72 and 73 when viewing FIG. 6 along the center longitudinal axis 43 of the reflector element 41.

The cutting plane 53 intersects the boundary plane 51 along a straight line denoted with reference numeral 76. This straight line extends perpendicular to the paper plane according to FIG. 6

and hence perpendicular to the center longitudinal axis 43 of the reflector element.

In the two examples according to FIGS. 2 and 6, in the installed state of the light fixture, the spread lens plate 23 is inclined at an acute angle in relation to the wall to be illuminated, preferably at an angle of approximately 50°. The spread lens plate 23 can furthermore also preferably be inclined at an angle ranging between 20° and 70° in relation to the wall to be illuminated.

## Claims

1. A light fixture (10) for illuminating a building surface (15), comprising a cup- shaped base body (11) having a light emission opening (24), a light source (12) being disposed on the inside (31) of the body, wherein indirect lighting portions (30a, 30b, 30c) starting from the light source can pass the light emission opening only after being reflected on reflector surfaces (21, 22) and direct lighting portions (29a, 29b, 29c) starting from the light source pass without reflection on reflector surfaces, wherein in the region of the light emission opening a spread lens plate (23) is provided, which ensures that the lighting portions are spread in order to make the illumination of the building surface more even, and wherein the reflector surfaces comprise a wall section (22) with a parabolic cross-section and a wall section (21) with an elliptic cross-section.

2. The light fixture according to claim 1, characterized in that the base body (11) has a tub shape.

3. The light fixture according to claim 2, characterized in that the light source (12) has an axially elongated configuration.

4. The light fixture according to claim 2 or 3, characterized in that the spread lens plate (23) ensures a spreading of the light in the axial direction (x).

5. A light fixture according to any one of the claims 2 to 4, characterized in that the base body (11) and/or the wall sections (21, 22) are configured cylindrically.

6. A light fixture according to any one of the claims 2 to 5, characterized in that the spread lens plate (23) comprises a plurality of ribs extending transversely to the axial extension (x) to form cylindrical lenses (34a, 34b, 34c).

7. A light fixture according to any one of the preceding claims, characterized in that a metal halide lamp, particularly an HID lamp, or a low-voltage halogen incandescent lamp, is provided as the light source (12).

8. A light fixture according to any one of the preceding claims, characterized in that the wall sections (21, 22) are made of metal, particularly of aluminum, and in particular are configured to be highly reflective.

9. A light fixture according to any one of the preceding claims, characterized in that the light fixture (10) is configured as a wallwasher.

10. A light fixture according to any one of the preceding claims, characterized in that the light fixture (10) is configured as an in-ground light fixture.

11. A light fixture according to any one of the preceding claims, characterized in that the light source (12) is disposed in the focal point (F) or close to the focal point of the elliptic wall section (21) and in the focal point (F) or close to the focal point of the parabolic wall section (22).

12. A light fixture according to any one of the preceding claims, characterized in that the light fixture uniformly illuminates the building surface (15).

13. A light fixture according to any one of the preceding claims, characterized in that the elliptic wall section (21) extends approximately across a 2052 angle of circumference (U1) region around the light source.

14. A light fixture according to any one of the preceding claims, characterized in that the parabolic wall section (22) extends approximately across a 452 angle of circumference (U2) region around the light source.

15. A light fixture according to any one of the preceding claims, characterized in that the parabolic wall section (22) is disposed relative to the light source (12) such that the lighting portions (30b) reflected thereon primarily illuminate a region (for example 20 in FIG. 1) of the building surface that is removed from the light fixture and/or that the elliptic wall section (21) is disposed relative to the light source (12) such

that the lighting portions reflected thereon primarily illuminate a region of the building surface (15) that is close to the light fixture.

16. A light fixture according to any one of the preceding claims, characterized in that the spread lens plate (23) is oriented substantially transversely to a main radiation direction of the light fixture and particularly at an incline to the wall to be illuminated.

17. A light fixture according to any one of the preceding claims, characterized in that the light fixture comprises a dark-light reflector section (26) in the light radiation direction behind the spread lens plate (23).

18. A light fixture according to any one of the preceding claims, characterized in that the elliptic wall section (21) and the parabolic wall section (22) are connected by means of a particularly planar intermediate element (27).

19. A light fixture according to any one of the preceding claims, characterized in that in the light radiation direction of the light source a dimming element (28) is provided in front of the parabolic wall section (22).

20. A light fixture (40) for illuminating building surfaces (15), comprising a substantially cup-shaped reflector

element (41) extending along a center longitudinal axis (43) from an apex region (44) to a light emission opening (24), at least one lamp (42) being providable on the inside of the element, wherein indirect lighting portions (47a, 47b, 48a, 48b) starting from the light source can only pass through the light emission opening after having been reflected on the inside (69) of the reflector element and direct lighting portions starting from the light source can pass without reflection on the inside (69) of the reflector element, wherein in the region of the light emission opening a spread lens plate (23) is provided, which ensures a spreading of the lighting portions to help produce a more uniform illumination of the building surface, and wherein on the inside (69) of the reflector element (41) a plurality of segments (59a, 59b, 59c) comprising surfaces (1c) arched toward the inside are disposed.

21. The light fixture according to claim 20, characterized in that the reflector element (41) is made of metal.

22. The light fixture according to claim 21, characterized in that the reflector element (41) is made of press-formed aluminum.

23. A light fixture according to any one of the claims 20 to 22, characterized in that the reflector element (41) comprises a base body that is configured rotation- symmetrical about the center longitudinal axis (43) with respect to its basic shape, the body being cut off or severed in the region of the light

emission opening along a plane (53) at an incline to the center longitudinal axis (43) or comprising a boundary (45, 46) surrounding the light emission opening (24), the boundary extending along a plane (53) oriented at an incline to the center longitudinal axis (43) of the reflector element (41).

24. The light fixture according to claim 23, characterized in that the spread lens plate (23) is disposed along the plane (53) or cutting plane (53) relative to the reflector element (41).

25. A light fixture according to any one of the claims 20 to 24, characterized in that at least some segments (59a, 59b, 59c, 59k) are each formed by a section of a cylinder (FIG. 17), particularly a circular cylindrical body.

26. A light fixture according to any one of the claims 20 to 25, characterized in that all segments (59a, 59b, 59k) are each formed by a section of a cylinder, particularly a circular cylindrical body.

27. The light fixture according to claim 25 or 26, characterized in that the center line (66k) of the cylinder (59k) is oriented substantially parallel to the center longitudinal axis (43) of the reflector element (43) [sic] or inclined to the same at an angle of less than 45°.

28. A light fixture according to any one of the claims 25 to 27, characterized in that the inclination of the center lines (66ab, 66ac, 66ai, 66am) of the cylinders (59ab, 59af, 59ai, 59am), particularly the inclination thereof relative to a tangent (68ab, 68ai) that can be placed on the outside (74) of the reflector element (41), varies as a function of the distance of the cylinder from the apex (44) of the reflector.

29. The light fixture according to claim 28, characterized in that the variation of the inclination of the cylinder axes (66ab, 66af, 66ai, 66am) of at least several segments of an angle of circumference region is selected such that the light beams emitted by the light source (42) and impinging upon these cylindrical segments intersect in a focal point (B).

30. The light fixture according to claim 29, characterized in that the focal point (B) is located outside of the light emission opening (24) of the reflector element (41).

31. The light fixture according to claim 30, characterized in that the focal point (B) is located close to or in the light emission opening (38) of the light fixture (40).

32. A light fixture according to any one of the claims 25 to 31, characterized in that the cylinder axes (66) of a plurality of cylinders (59) having the same distance to the apex region (44) of the reflector element (41) have the same inclination to the center longitudinal axis (43) of the reflector element.

33. A light fixture according to any one of the preceding claims, characterized in that the inside (69) of the

reflector element (41) is provided with segments (59) along the entire circumference.

34. The light fixture according to claim 33, characterized in that the inside (69) of the reflector element (41) is divided into at least two partial regions (72, 73).

35. The light fixture according to claim 34, characterized in that in the different partial regions (72, 73) differently arched and/or differently sized segments are disposed or a varying areal density of segments exists.

36. A light fixture according to any one of the preceding claims, characterized in that the segments are disposed along rows (for example the row formed by segments 63a, 63b, 63c) extending in a circular fashion about the center longitudinal axis (43) of the reflector element (41) and along columns (for example the column formed by segments 64a, 64b, 64c) extending transversely thereto.

37. A light fixture according to claims 34 and 36, characterized in that the different partial regions (72, 73) are associated with different row numbers.

38. The light fixture according to claim 34, characterized in that the cylindrical elements within a partial region (72, 73) are identical in size.

39. The light fixture according to claim 34, characterized in that the reflector element comprises two partial regions (72, 73), which each take up an angle of circumference region of approximately 180°.

40. The light fixture according to claim 34 or according to a claim referring back to claim 34, characterized in that in the second partial region (73) segments

are provided which primarily or at least partly imitate a reflection behavior of a reflector having a parabolic cross-section.

41. The light fixture according to claim 40, characterized in that in the first partial region (72) segments are provided which primarily or at least partly imitate a reflection behavior of a reflector having an elliptic cross-section.

42. The light fixture according to claim 34 or a claim referring back to claim 34, characterized in that the first partial region (72) and the second partial region (73) are separated by a boundary plane (51).

43. A light fixture according to claims 23 and 42, characterized in that the boundary plane (51) and the cutting plane (53) intersect along a straight line (76), which is disposed perpendicular to the center longitudinal axis (43).

44. A light fixture according to any one of the preceding claims, characterized in that, when viewing a largest cross-sectional surface (52) of the reflector element (41), a plurality of segments of a first type are disposed on the first side of the center longitudinal axis (43) of the reflector element and a plurality of segments of a second type are disposed on the other side of the center longitudinal axis.

45. A light fixture according to any one of the preceding claims, characterized in that, when viewing a

cross-sectional surface (51) which is disposed perpendicular to the largest cross-sectional surface (52), a symmetrical configuration of the reflector element (41) in relation to the center longitudinal axis (43) is apparent.

46. The light fixture according to claim 44, characterized in that the segments of a first type (partial region 72) primarily imitate a reflection behavior of a reflector having an elliptic cross-section.

47. The light fixture according to any one of the preceding claims, characterized in that the segments of a second type (partial region 73) primarily imitate a reflection behavior of a reflector having a parabolic cross-section.

48. A light fixture according to any one of the claims 20 to 47, characterized in that the light source (42) is a substantially punctiform source.

49. The light fixture according to claim 48, characterized in that a metal halide lamp, particularly an HID lamp, or a low-voltage halogen incandescent lamp, or at least an LED, is provided as the light source.

50. A light fixture according to any one of the claims 20 to 49, characterized in that the spread lens plate (23) ensures a spreading of the light in a direction (line 51 in FIG. 13) transversely to the largest cross-sectional surface (52).

51. A light fixture according to any one of the claims 20 to 50, characterized in that the spread lens plate (23) comprises a plurality of ribs to form cylindrical lenses (34a, 34b,

34c), the ribs extending along a direction parallel to the largest cross-sectional surface (52).

52. A light fixture according to any one of the claims 50 to 51, characterized in that the light fixture (40) is configured as a wallwasher.

53. A light fixture according to any one of the claims 20 to 52, characterized in that the light fixture (40) is configured as recessed light fixture or as a spotlight to be mounted on the ceiling.

54. A light fixture according to any one of the claims 20 to 53, characterized in that the light fixture uniformly illuminates the building surface (15).

55. A light fixture according to any one of the claims 20 to 54, characterized in that the light source (42) is located in the focal point (F) or close to the focal point of a parabolic base body of the reflector element (41).

56. A light fixture according to any one of the claims 20 to 55, characterized in that a partial region (73) of the reflector for imitating a light distribution of a parabolic reflector is disposed relative to the light source such that the lighting portions reflected thereon primarily illuminate a region of the building surface (15) that is removed from the light fixture (40) and/or that a partial region (72) of the reflector for imitating a light distribution of a reflector having an elliptic cross-section is disposed relative to the light source such that the lighting portions reflected thereon primarily illuminate a

region of the building surface (15) that is close to the light fixture (40).

57. A light fixture according to any one of the claims 20 to 56, characterized in that the spread lens plate (23) is oriented substantially transversely to a main radiation direction of the light fixture and at an incline to the wall (15) to be illuminated.

58. A light fixture according to any one of the preceding claims, characterized in that the light fixture comprises a dark-light reflector section (26) in the light radiation direction behind the spread lens plate (23).

59. A light fixture (40) for illuminating building surfaces (15), particularly according to any one of the claims 20 to 58, comprising a first reflector element (41) having a substantially cup-shaped configuration and widening along a center longitudinal axis (43) from an apex region (44) toward a light emission opening (24), at least one lamp (42) being providable on the inside of the element, wherein in the region of the light emission opening a spread lens plate (23) can be provided, which ensures a spreading of the lighting portions to help produce a more uniform illumination of the building surface, wherein the first reflector element is provided with a plurality of segments (59a, 59b, 59c) having a surface arched toward the inside, the segments being disposed on the inside (69), wherein the reflector element comprises a base body configured rotational-symmetrical about the central longitudinal axis with respect to the basic shape, the body being cut off or severed in the region of the light emission opening thereof along a plane (53) at an incline to the center longitudinal axis (43), or comprising a boundary (45, 46) surrounding the light emission opening, the boundary extending along a plane (53) which is oriented at an incline in relation to the center longitudinal axis of the reflector element, wherein the first reflector element can be replaced with a second reflector element having the same outer dimensions, and wherein the second reflector element on the inside thereof comprises a plurality of segments having a surface arched toward the inside, wherein the types of the segments and/or the configuration of the segments and/or the curvatures of the segments are selected differently in

order to achieve a light radiation characteristic that differs from that of the first reflector element.