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(72) Inventors:
• **Hietbrink, Roelant Boudewijn**
5656 AE Eindhoven (NL)
• **Salters, Bart Andre**
5656 AE Eindhoven (NL)

(74) Representative: **Philips Intellectual Property & Standards**
High Tech Campus 52
5656 AG Eindhoven (NL)

(71) Applicant: **Koninklijke Philips N.V.**
5656 AG Eindhoven (NL)

(54) **ANTI-FOULING UNIT CONFIGURED TO BE ARRANGED ON A SURFACE**

(57) An anti-fouling unit (1) is configured to be arranged on a surface and comprises at least one electric circuit (30) including a light-emitting arrangement (31) configured to emit anti-fouling light and a power-receiving arrangement (33) configured to receive power to be used for powering the light-emitting arrangement (31) from an external power-supplying arrangement located on or near the surface. Further, the anti-fouling unit (1) comprises

a carrier slab (40) carrying the at least one electric circuit (30) and having an emission surface (41). The power-receiving arrangement (33) is configured to allow positioning the anti-fouling unit (1) on the surface in at least two distinct orientations both involving enablement of the power-receiving arrangement (33) to effectively receive power from the external power-supplying arrangement.

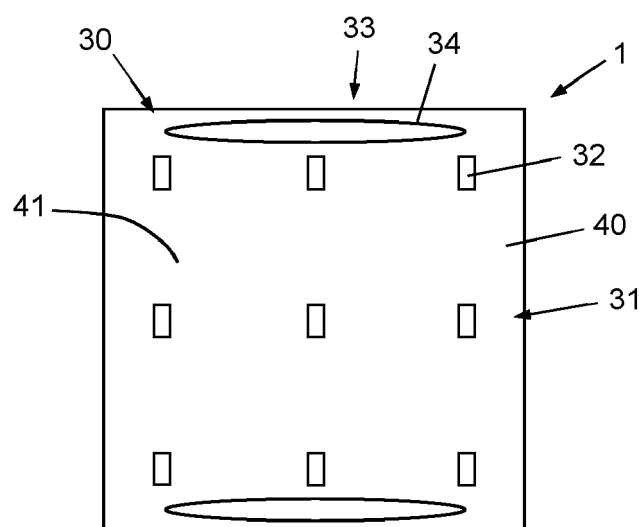


Fig. 1

Description

FIELD OF THE INVENTION

[0001] In the first place, the invention relates to an anti-fouling unit configured to be arranged on a surface, wherein the anti-fouling unit comprises at least one electric circuit including a light-emitting arrangement configured to emit anti-fouling light and a power-receiving arrangement configured to receive power to be used for powering the light-emitting arrangement from an external power-supplying arrangement located on or near the surface, and a plate-shaped carrier slab carrying the at least one electric circuit, and wherein the carrier slab has an emission surface configured to allow light from the light-emitting arrangement of the at least one electric circuit to pass to outside of the anti-fouling unit and to thereby subject an exterior side of the emission surface and surroundings thereof to an anti-fouling action.

[0002] In the second place, the invention relates to an assembly of an object and a plurality of anti-fouling units as mentioned arranged on a surface of the object.

BACKGROUND OF THE INVENTION

[0003] In general, the invention is in the field of anti-fouling of surfaces. Fouling of surfaces that are exposed to water, during at least a part of their lifetime, is a well-known phenomenon that causes substantial problems in many fields. For example, in the field of shipping, biofouling on the hull of ships is known to cause a severe increase in drag of the ships, and thus increased fuel consumption of the ships. In this respect, it is estimated that an increase of up to 40% in fuel consumption can be attributed to biofouling.

[0004] In general, biofouling is the accumulation of microorganisms, plants, algae, small animals and the like on surfaces. According to some estimates, over 1,800 species comprising over 4,000 organisms are responsible for biofouling. Hence, biofouling is caused by a wide variety of organisms, and involves much more than an attachment of barnacles and seaweeds to surfaces. Biofouling is divided into micro fouling which includes biofilm formation and bacterial adhesion, and macro fouling which includes the attachment of larger organisms. Due to the distinct chemistry and biology that determine what prevents them from settling, organisms are also classified as being hard or soft. Hard fouling organisms include calcareous organisms such as barnacles, encrusting bryozoans, mollusks, polychaetes and other tube worms, and zebra mussels. Soft fouling organisms include non-calcareous organisms such as seaweed, hydroids, algae and biofilm "slime". Together, these organisms form a fouling community.

[0005] Biofouling can cause machinery to stop working and water inlets to get clogged, to mention only two other negative consequences than the above-mentioned increase of drag of ships. In any case, the topic of anti-

biofouling, i.e. the process of removing and/or preventing biofouling, is well-known.

[0006] WO 2014/188347 A1 discloses a method of anti-fouling of a surface while said surface is at least partially submerged in a liquid environment, in particular an aqueous or oily environment. The method involves providing an anti-fouling light and providing an optical medium in close proximity to such a protected surface, the optical medium having a substantially flat emission surface. At least part of the light is distributed through the optical medium in a direction substantially parallel to the protected surface, and the anti-fouling light is emitted from the emission surface of the optical medium, in a direction away from the protected surface. The anti-fouling light may be ultraviolet light, and the optical medium may comprise ultraviolet transparent silicone, i.e. silicone that is substantially transparent to ultraviolet light, and/or ultraviolet grade fused silica, in particular quartz.

[0007] By applying the method known from WO 2014/188347 A1, it is possible to cover a protected surface to be kept clean from biofouling, at least to a significant extent, with a layer that emits germicidal light. The protected surface can be the hull of a ship, as mentioned earlier, but the method is equally applicable to other types of surface.

[0008] WO 2014/188347 A1 further discloses a lighting module that is suitable to be used for putting the above-mentioned method to practice. Thus, the lighting module comprises at least one light source for generating anti-fouling light and an optical medium for distributing the anti-fouling light from the light source. The at least one light source and/or the optical medium may be at least partially arranged in, on and/or near the protected surface so as to emit the anti-fouling light in a direction away from the protected surface.

[0009] The lighting module known from WO 2014/188347 A1 may be provided as a foil that is suitable for application to the protected surface. The foil may be substantially size-limited in two orthogonal directions perpendicular to a thickness direction of the foil, so as to provide a tile-shaped anti-fouling unit; in another embodiment, the foil is substantially size-limited in only one direction perpendicular to the thickness direction of the foil, so as to provide an elongated strip of anti-fouling foil.

[0010] The concept of having tile-shaped anti-fouling units is particularly interesting when it comes to subjecting large surfaces to an anti-fouling action, which may be surfaces being as large as up to more than 10,000 m². It may especially be envisaged to arrange the anti-fouling units in a plane filling pattern for covering at least a substantial part of a surface. Anti-fouling units can be of any suitable shape and size. For example, square units may be used and arranged in a regular pattern on a ship's hull for forming an anti-fouling light emitting device on the hull, wherein each unit may be dimensioned so as to cover about 1 m² of the hull. In any case, the anti-fouling units are configured to be arranged on a surface, which surface may be referred to as a/the protected surface.

[0011] As indicated in the foregoing, the invention relates to an anti-fouling unit comprising i) at least one electric circuit including a light-emitting arrangement configured to emit anti-fouling light, and ii) a plate-shaped carrier slab carrying the at least one electric circuit, wherein the carrier slab has an emission surface configured to allow light from the light-emitting arrangement of the at least one electric circuit to pass to outside of the anti-fouling unit and to thereby subject an exterior side of the emission surface and surroundings thereof to an anti-fouling action. The at least one electric circuit further includes a power-receiving arrangement configured to receive power from outside of the anti-fouling unit to be used for powering the light-emitting arrangement. In practical cases of applying a plurality of anti-fouling units to a surface, it is important to choose an appropriate positioning of each of the anti-fouling units on the surface, particularly a positioning in which the power receiving arrangement of the at least one electric circuit of each of the anti-fouling units is actually enabled to receive power from an external power-supplying arrangement, wherein it is to be noted that such an external power-supplying arrangement may be located on or near the surface in a suitable configuration. For example, such an external power-supplying arrangement may comprise a number of elongated power-supplying strips comprising a plurality of electric coils arranged in a row and extending at appropriate positions on the surface.

SUMMARY OF THE INVENTION

[0012] It is an object of the invention to facilitate a process of correctly positioning an anti-fouling unit on a surface during a process of applying the anti-fouling unit to the surface, especially when it comes to realizing a functional position of the power-receiving arrangement of the at least one electric circuit of the anti-fouling unit relative to an external power-supplying arrangement as may be present on or near the surface. In view thereof, the invention provides an anti-fouling unit configured to be arranged on a surface, wherein the anti-fouling unit comprises at least one electric circuit including a light-emitting arrangement configured to emit anti-fouling light and a power-receiving arrangement configured to receive power to be used for powering the light-emitting arrangement from an external power-supplying arrangement located on or near the surface, and a plate-shaped carrier slab carrying the at least one electric circuit, wherein the carrier slab has an emission surface configured to allow light from the light-emitting arrangement of the at least one electric circuit to pass to outside of the anti-fouling unit and to thereby subject an exterior side of the emission surface and surroundings thereof to an anti-fouling action, and wherein the power-receiving arrangement is configured to allow positioning the anti-fouling unit on the surface in at least two distinct orientations both involving enablement of the power-receiving arrangement to effectively receive power from the external power-supply-

ing arrangement.

[0013] The invention also relates to an assembly of an object and a plurality of anti-fouling units as defined in the preceding paragraph arranged on a surface of the object. The object may be a marine object, in which case the term "marine object" should be understood such as to refer to an object comprising at least one surface that is intended to be at least partially submersed in a fouling liquid containing biofouling organisms during at least a part of the lifetime of the object. In the context of the present text, the term "marine object" is not limited to objects for use in salt water, but is to be understood so as to include objects for use in fresh water as well. Examples of marine objects include ships and other vessels, marine stations, sea-based oil or gas installations, buoyancy devices, support structures for wind turbines at sea, structures for harvesting wave/tidal energy, sea chests, underwater tools, etc.

[0014] According to the invention, a specific configuration of the power-receiving arrangement of the at least one electric circuit of the anti-fouling unit is chosen, namely a configuration involving a possibility of positioning the anti-fouling unit on the surface in at least two distinct orientations and having enablement of the power-receiving arrangement to effectively receive power from an external power-supplying arrangement in all of the at least two distinct orientations. It is an insight of the invention that this possibility can be obtained on the basis of the configuration of the power-receiving arrangement, wherein it is not necessary to have one or more other adaptations of the design of the anti-fouling unit. When the invention is applied, the anti-fouling unit can even do without exterior indicators/markers in respect of the way in which the anti-fouling unit is to be oriented relative to a power-supplying strip or the like. A notable advantage of the invention is that when it comes to applying a plurality of anti-fouling units to a surface, it is possible to create a situation in which it is not necessary for the person(s) involved in doing so to perform special checks in order to guarantee that a particular orientation of the anti-fouling units relative to a power-supplying arrangement is realized. The fact is that a situation in which only a single predetermined possibility exists in respect of a functional position of the at least one electric circuit of the anti-fouling unit relative to an external power-supplying arrangement is avoided. Other advantages of the invention will become apparent from the following descriptions of options covered by the invention.

[0015] The difference between the at least two distinct orientations of the anti-fouling unit on the surface may be of any suitable value, depending on the shape of the periphery of the carrier slab, and may correspond to a turn of the anti-fouling unit on the surface over any suitable angle. In a practical case, it may be so that the difference as mentioned corresponds to a turn of the anti-fouling unit on the surface over at least 45°. In view of the fact that practical options in respect of the shape of the periphery of the carrier slab include a trapezoidal

shape, a square shape, a rectangular shape, a triangular shape and a hexagonal shape, practical values of the difference between the at least two distinct orientations include 60°, 90°, 120° and 180°.

[0016] The power-receiving arrangement may comprise a single functional power-receiving component that is centrally arranged in the carrier slab or at least two functional power-receiving components configured to function independently from each other. In the first case, it may be practical if the functional power-receiving component is arranged to surround an area of the carrier slab including the center of gravity of the carrier slab and/or if the single functional power-receiving component is ring-shaped. In the latter case, another advantage may be an improvement of electrical redundancy of an anti-fouling unit, that is to say, improvement of the ability of the at least one electric circuit of the anti-fouling unit to function under all circumstances during the lifetime of the anti-fouling unit, even in various possible cases of damage and/or failure. The fact is that when the power-receiving arrangement comprises at least two functional power-receiving components configured to function independently from each other, situations may be created in which an anti-fouling unit is positioned relative to an external power-supplying arrangement in such a way that receipt of power can take place through either one of the functional power-receiving components, so that in case of damage and/or failure of one of the functional power-receiving components, the necessary power supply line to the at least one electric circuit of the anti-fouling unit is still not broken. In respect of the nature of the functional power-receiving component(s) it is to be noted that it may be practical if the single functional power-receiving component or at least one of the at least two functional power-receiving components comprises an electric coil.

[0017] In one feasible embodiment of the anti-fouling unit according to the invention, the carrier slab has at least three straight sides, wherein at least one of the functional power-receiving components is located at one of the straight sides of the carrier slab, and wherein at least one other of the functional power-receiving components is located at at least one other of the straight sides of the carrier slab. In this respect, it may be so that the power-receiving arrangement comprises at least as many functional power-receiving components as the carrier slab has straight sides, wherein at least one functional power-receiving component is located at each one of the straight sides. In such a case, when it is intended to position the anti-fouling unit on the surface while covering/facing something like a power-supplying strip at one side, it does not matter which side of the anti-fouling unit is chosen to actually cover/face the power-supplying strip.

[0018] According to one option, it may be so that the carrier slab has a mirror symmetrical periphery, and that at least two functional power-receiving components are located at mirror symmetrical positions in the carrier slab. This applies to a possible embodiment of the anti-fouling unit in which the carrier slab is of trapezoidal shape, and

in which the power-receiving arrangement of the at least one electric circuit of the anti-fouling unit comprises two functional power-receiving components positioned near each of the slanted sides of the trapezoidal shape, aligned with the axis of mirror symmetry of the trapezoidal shape. In such a case, the anti-fouling unit can be rotated on the surface over 180° and still have a similar positioning and orientation of a functional power-receiving component relative to an external power-supplying arrangement.

[0019] According to another option, it may be so that the carrier slab has a rotation symmetrical periphery, and that at least two functional power-receiving components are located at rotation symmetrical positions or non-rotation symmetrical positions in the carrier slab. For example, if the shape of the periphery of the carrier slab is rectangular, two functional power-receiving components may be located such that the components are at the same location for half turns of the carrier slab on a surface, i.e. turns of the carrier slab over 180°. On the other hand, if the shape of the periphery of the carrier slab is rectangular, it may be handy if one of the components is located along the short side of the carrier slab and if another of the components is located along the long side of the carrier slab, so that the anti-fouling unit can be arranged in one of two different orientations relative to an external power-supplying arrangement, the different orientations being associated with a turn of the carrier slab over 90°.

[0020] In respect of the carrier slab it is to be noted that an example of an appropriate material of the carrier slab is silicone. Further, a configuration is possible in which the at least one electric circuit is embedded in the material of the carrier slab. In respect of the light-emitting arrangement it is to be noted that the light-emitting arrangement may include at least one LED, for example. In respect of the anti-fouling light it is to be noted that the invention covers the use of any suitable type of anti-fouling light, including the use of ultraviolet light.

[0021] A method of applying a plurality of anti-fouling units as defined in the foregoing to a surface may involve arranging the anti-fouling units on the surface in a plane filling pattern, for example. In the process, it may be so that the anti-fouling units are positioned alongside each other in a closely adjoining fashion. For the sake of completeness, it is noted that the term "plane filling pattern" should be understood in a practical sense, i.e. so as to cover various options which would normally be denoted by a skilled person by means of the term, including the above-mentioned option according to which anti-fouling units are arranged in a closely adjoining fashion, with practically no space between the anti-fouling units, and an option according to which anti-fouling units are arranged beside each other with only a narrow space between them. In general, the term is applicable to both a pattern in which the anti-fouling units are arranged so as to form a continuous cover of a surface and a pattern in which the anti-fouling units are arranged so as to form a cover of a surface that is provided with interruptions, the

interruptions being no more than small areas between the anti-fouling units, wherein the larger part of the total area of the pattern is occupied by the anti-fouling units. In any case, it may particularly be so that mutual distances between anti-fouling units are significantly smaller than general dimensions of the anti-fouling units.

[0022] In respect of the assembly of an object and a plurality of anti-fouling units arranged on a surface of the object, it is noted that it is possible that all anti-fouling units are of a single type, in other words, that the anti-fouling units are identical, but that does not alter the fact that it is also possible that anti-fouling units of two or even more different types are included in the plurality of anti-fouling units, in a periodic or aperiodic layout. In this respect, it may especially be practical if anti-fouling units including carrier slabs of at least two different peripheral shapes are combined.

[0023] The above-described and other aspects of the invention will be apparent from and elucidated with reference to the following detailed description of practical embodiments of an anti-fouling unit that is configured to be arranged on a surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The invention will now be explained in greater detail with reference to the figures, in which equal or similar parts are indicated by the same reference signs, and in which:

Fig. 1 diagrammatically shows an anti-fouling unit according to a first practical embodiment of the invention,

Fig. 2 diagrammatically shows a number of anti-fouling units according to a second practical embodiment of the invention and illustrates how the anti-fouling units can be used for covering a conical surface,

Fig. 3 illustrates two different ways in which an anti-fouling unit according to a third practical embodiment of the invention can be positioned relative to a power-supplying strip,

Fig. 4 illustrates a possibility in respect of a pattern of anti-fouling units according to a fourth practical embodiment of the invention,

Fig. 5 illustrates how an anti-fouling unit according to the fourth practical embodiment of the invention can be positioned relative to a power-supplying strip,

Fig. 6 diagrammatically shows an anti-fouling unit according to a fifth practical embodiment of the invention,

Fig. 7 diagrammatically shows an anti-fouling unit according to a sixth practical embodiment of the invention,

Fig. 8 diagrammatically shows an anti-fouling unit according to a seventh practical embodiment of the invention,

Fig. 9 diagrammatically shows an anti-fouling unit

according to an eighth practical embodiment of the invention,

Fig. 10 diagrammatically shows an anti-fouling unit according to a ninth practical embodiment of the invention,

Fig. 11 diagrammatically shows an anti-fouling unit according to a tenth practical embodiment of the invention,

Fig. 12 diagrammatically shows an anti-fouling unit according to an eleventh practical embodiment of the invention,

Figs. 13 and 14 illustrate practical options in respect of the configuration of an electric circuit of an anti-fouling unit, and

Fig. 15 diagrammatically shows a side view of a carrier slab of an anti-fouling unit.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0025] Fig. 1 diagrammatically shows an anti-fouling unit 1 according to a first practical embodiment of the invention. The anti-fouling unit 1 is configured to be arranged on a surface 20 and is operable to perform an anti-fouling action by emitting anti-fouling light. An example of a surface 20 is diagrammatically shown in Fig. 2. The surface 20 may be an exterior surface of a marine object, for example. The surface 20 shown in Fig. 2 is of conical shape and is just one example of numerous types of surface on which at least one anti-fouling unit according to the invention might be arranged.

[0026] In general, the anti-fouling unit according to the invention comprises at least one electric circuit 30 including a light-emitting arrangement 31 configured to emit the anti-fouling light, and a plate-shaped carrier slab 40 carrying the at least one electric circuit 30. In this respect, it may be practical if the at least one electric circuit 30 is embedded in the material of the carrier slab 40. The carrier slab 40 has an emission surface 41 configured to allow light from the light-emitting arrangement 31 of the at least one electric circuit 30 to pass to outside of the anti-fouling unit and to thereby subject an exterior side of the emission surface 41 and surrounding thereof to an anti-fouling action. For the sake of completeness, it is noted that when the anti-fouling unit is arranged on a surface 20, the anti-fouling unit contacts the surface 20 through another surface of the carrier slab 40 than the emission surface 41. For the purpose of enabling the anti-fouling unit to follow the shape of a non-flat portion of a surface 20, it is practical if the material of the carrier slab 40 is flexible. Further, it is practical if the material of the carrier slab 40 is transparent to the anti-fouling light, which may be ultraviolet light, for example, wherein the carrier slab 40 may be configured to distribute the anti-fouling light.

[0027] The carrier slab 40 of the anti-fouling unit 1 according to the first practical embodiment of the invention has a square periphery. Besides the surface 20, Fig. 2 diagrammatically shows a number of anti-fouling units 2

according to a second practical embodiment of the invention. The carrier slab 40 of the anti-fouling unit 2 according to the second practical embodiment of the invention has a trapezoidal periphery. In general, numerous shapes of the periphery of the carrier slab 40 are possible in the framework of the invention. A square shape of the periphery of the carrier slab 40 can also be seen in Figs. 7 and 8, which relate to an anti-fouling unit 6 according to a sixth practical embodiment of the invention and an anti-fouling unit 7 according to a seventh practical embodiment of the invention, respectively. A trapezoidal shape of the periphery of the carrier slab 40 can also be seen in Figs. 4 and 5, which relate to an anti-fouling unit 4 according to a fourth practical embodiment of the invention, and Fig. 6, which relates to an anti-fouling unit 5 according to a fifth practical embodiment of the invention. Other examples of the shape of the periphery of the carrier slab 40 include a hexagonal shape as can be seen in Figs. 11 and 12, which relate to an anti-fouling unit 10 according to a tenth practical embodiment of the invention and an anti-fouling unit 11 according to an eleventh practical embodiment of the invention, respectively, and a rectangular shape as can be seen in Figs. 3, 9 and 10, which relate to an anti-fouling unit 3 according to a third practical embodiment of the invention, an anti-fouling unit 8 according to an eighth practical embodiment of the invention and an anti-fouling unit 9 according to a ninth practical embodiment of the invention, respectively.

[0028] As mentioned in the foregoing, in the anti-fouling unit 1 according to the first practical embodiment of the invention, the carrier slab 40 has a square periphery. Further, the anti-fouling unit 1 comprises a single electric circuit 30. In Fig. 1, light sources 32 included in the light-emitting arrangement 31 of the electric circuit 30 are diagrammatically depicted as rectangles. The electric circuit 30 also comprises a power-receiving arrangement 33 that is configured to receive power from outside of the anti-fouling unit 1 to be used for powering the light-emitting arrangement 31. The power-receiving arrangement 33 comprises two functional power-receiving components 34, which are diagrammatically indicated in Fig. 1 as ovals.

[0029] In general, it is practical if the power-receiving arrangement 33 of an electric circuit 30 of an anti-fouling unit according to the invention comprises one or more functional power-receiving components 34 such as electric coils. When the number of functional power-receiving components 34 is at least two, it may be so that the at least two functional power-receiving components 34 are configured to function independently from each other, so that power supply to the electric circuit 30 can be realized through either one of the functional power-receiving components 34, which allows for an enhanced degree of freedom in positioning the anti-fouling unit on the surface 20 assuming that power can only be picked up at certain predetermined positions on the surface 20, which is the case when power-supplying strips 26 or the like are present on the surface 20. Portions of a power-supplying

strip 26 as may be included in an external power-supplying arrangement 25 are diagrammatically shown in Figs. 3 and 5, wherein it is to be noted that it may be practical if the power-supplying strip 26 comprises a plurality of electric coils 27 arranged in a row, as illustrated in Fig. 3.

[0030] Fig. 3 illustrates two different ways in which the anti-fouling unit 3 according to the third practical embodiment of the invention can be positioned relative to a power-supplying strip 26. As mentioned earlier, the periphery of the carrier slab 40 of the anti-fouling unit 3 according to the third practical embodiment of the invention is of rectangular shape. In order to allow for both an option of arranging the anti-fouling unit 3 with its long axis extending in the direction in which the power-supplying strip 26 extends, as shown at the left side of Fig. 3, and an option of arranging the anti-fouling unit 3 with its short axis extending in the direction in which the power-supplying strip 26 extends, as shown at the right side of Fig. 3, it is advantageous that the power-receiving arrangement 33 comprises a functional power-receiving component 34 that is centrally arranged in the carrier slab 40. In particular, as shown, the functional power-receiving component 34 may be ring-shaped, wherein the center of gravity of the carrier slab 40 is in an area surrounded by the functional power-receiving component 34. As an alternative, equipping the anti-fouling unit 3 with at least two functional power-receiving components 34 is feasible, as will be explained later with reference to Figs. 10 and 11.

[0031] Fig. 4 illustrates how anti-fouling units 4 according to the fourth practical embodiment of the invention can be arranged in a row. As mentioned earlier, the periphery of the carrier slab 40 of the anti-fouling unit 4 according to the fourth practical embodiment of the invention is of trapezoidal shape. A characteristic of the trapezoidal shape of the carrier slab 40 is that the anti-fouling units 4 can be arranged in a straight row by alternately rotating the anti-fouling unit 4 on the surface 20 by 180°, assuming the symmetrical trapezoidal shape as shown. On the basis of the trapezoidal shape of the carrier slab 40, the anti-fouling units 4 are further very well suitable to be used for covering convexly curved surfaces 20, as already suggested with reference to Fig. 2, or concavely curved surfaces 20. Thus, the anti-fouling unit comprising a carrier slab 40 having a trapezoidal periphery can be widely used.

[0032] Fig. 5 illustrates that the anti-fouling unit 4 according to the fourth practical embodiment of the invention may be equipped with two independent functional power-receiving components 34 in a single electric circuit 30, and that one of the functional power-receiving components 34 can be arranged along the basis of the trapezoidal shape of the carrier slab 40 of the anti-fouling unit 4, while the other of the functional power-receiving components 34 can be arranged along the top of the trapezoidal shape. In this way, it is achieved that the anti-fouling unit 4 can be positioned in two different ways relative to a power-supplying strip 26 and still be operable in the exact same manner.

[0033] Figs. 6, 7, 8, 9, 10, 11 and 12 serve to illustrate different options in respect of the peripheral shape of the carrier slab 40 of the anti-fouling unit and the number and positioning of functional power-receiving components 34 in the anti-fouling unit.

[0034] Fig. 6 illustrates the option of the shape of the carrier slab 40 being trapezoidal, the number of functional power-receiving components 34 being two, and the positioning of the functional power-receiving components 34 being near each of the slanted sides of the trapezoidal shape, aligned with the axis of mirror symmetry of the trapezoidal shape, whereby the positioning of the functional power-receiving components 34 is different from what is shown in Fig. 5.

[0035] Fig. 7 illustrates the option of the shape of the carrier slab 40 being square, the number of functional power-receiving components 34 being two, and the positioning of the functional power-receiving components 34 being at two opposite sides of the square shape. Fig. 8 illustrates the option of the shape of the carrier slab 40 being square, the number of functional power-receiving components 34 being four, and the positioning of the functional power-receiving components 34 being at each of the sides of the square shape so that there is an enhanced degree of freedom in arranging the anti-fouling unit 7 relative to one or two power-supplying strips 26.

[0036] Fig. 9 illustrates the option of the shape of the carrier slab 40 being rectangular, the number of functional power-receiving components 34 being two, and the positioning of the functional power-receiving components 34 being at two opposite long sides of the rectangular shape. Fig. 10 illustrates the option of the shape of the carrier slab 40 being rectangular, the number of functional power-receiving components 34 being two, and the positioning of the functional power-receiving components 34 being such that one of the functional power-receiving components 34 is located at a long side of the rectangular shape and that the other of the functional power-receiving components 34 is located at a short side of the rectangular shape. In respect of the option of the shape of the carrier slab 40 being rectangular, it is further noted that other configurations which are not shown but nevertheless covered by the invention include a configuration in which the number of functional power-receiving components 34 is two and the positioning of the functional power-receiving components 34 is at two opposite short sides of the rectangular shape and a configuration in which the number of functional power-receiving components 34 is four and the positioning of the functional power-receiving components 34 is at each of the sides of the rectangular shape.

[0037] Fig. 11 illustrates the option of the shape of the carrier slab 40 being hexagonal, the number of functional power-receiving components 34 being six, and the positioning of the functional power-receiving components 34 being at each of the sides of the hexagonal shape. Fig. 12 illustrates the option of the shape of the carrier slab 40 being hexagonal, the number of functional power-re-

ceiving components 34 being one, and the functional power-receiving component 34 being located at a central position in the carrier slab 40.

[0038] In the framework of the invention, numerous other options than the ones referred to in the foregoing are feasible. For example, it may be practical to have a triangular shape or a parallelepipedal shape of the carrier slab 40, wherein it may further be practical to have functional power-receiving components 34 at each of the sides of the carrier slab 40 or to have a single, centrally arranged functional power-receiving component 34.

[0039] Fig. 13 illustrates a first practical option in respect of the configuration of an electric circuit 30, wherein the electric circuit 30 shown includes two light sources 32 being LEDs and two power-receiving electric coils 34. Fig. 14 illustrates a second practical option in respect of the configuration of an electric circuit 30, wherein the electric circuit 30 shown includes two light sources 32 being LEDs and four power-receiving electric coils 34. Fig. 15 diagrammatically shows a side view of a carrier slab 40 of an anti-fouling unit and provides an illustration of the practical option of the at least one electric circuit 30 being embedded in the material of the carrier slab 40. In the shown example, the electric circuit 30 comprises a number of UV-C LEDs 32 arranged on a printed circuit board 35, power-receiving electric coils 34 (of which one can be seen in Fig. 15), and electric wiring 36 interconnecting the electric coils 34 and the printed circuit board 35. Emission of UV-C light by the UVC-LEDs is diagrammatically indicated by means of arrows.

[0040] For the sake of clarity, it is to be noted that each of Figs. 13 and 14 may seem to show something like a wiring scheme, however, in no way should that what is shown be interpreted so as to represent an actual, complete wiring scheme. Likewise, it is to be noted that the representation of Fig. 15 is of a diagrammatical character only.

[0041] It will be clear to a person skilled in the art that the scope of the invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the invention as defined in the attached claims. It is intended that the invention be construed as including all such amendments and modifications insofar they come within the scope of the claims or the equivalents thereof. While the invention has been illustrated and described in detail in the figures and the description, such illustration and description are to be considered illustrative or exemplary only, and not restrictive. The invention is not limited to the disclosed embodiments. The drawings are schematic, wherein details which are not required for understanding the invention may have been omitted, and not necessarily to scale.

[0042] Variations to the disclosed embodiments can be understood and effected by a person skilled in the art in practicing the claimed invention, from a study of the figures, the description and the attached claims. In the claims, the word "comprising" does not exclude other

steps or elements, and the indefinite article "a" or "an" does not exclude a plurality. Any reference signs in the claims should not be construed as limiting the scope of the invention.

[0043] Elements and aspects discussed for or in relation with a particular embodiment may be suitably combined with elements and aspects of other embodiments, unless explicitly stated otherwise. Thus, the mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0044] The terms "comprise" and "include" as used in this text will be understood by a person skilled in the art as covering the term "consist of". Hence, the term "comprise" or "include" may in respect of an embodiment mean "consist of", but may in another embodiment mean "contain/have/be equipped with at least the defined species and optionally one or more other species".

[0045] In the context of the examples described in the foregoing with reference to the figures, it is suggested that the anti-fouling units may be provided with one or more electric coils 34 for the purpose of receiving power from an external power-supplying arrangement 25, which may also comprise electric coils 27. This does not alter the fact that the invention covers other ways of supplying and receiving power and use of their associated components as well.

[0046] For the sake of clarity, it is noted that reference in the present text to rotation of the anti-fouling unit on the surface 20 over a certain angle as well as to rotation symmetrical aspects of the carrier slab 40 is to be understood in a context of the anti-fouling unit lying flat on the surface 20, in an intended and correct position with the emission surface 41 of the carrier slab 40 at the front, i. e. away from the surface 20, and the anti-fouling unit being rotated on that very spot, without being flipped over, meaning that the emission surface 41 of the carrier slab 40 stays at the front. Assuming a design of the carrier slab 40 with straight edges and flat sides, this implies rotation of the carrier slab 40 about an axis extending in the direction of a normal of the emission surface 41 of the carrier slab 40.

[0047] Notable aspects of the invention are summarized as follows. An anti-fouling unit is configured to be arranged on a surface 20 and comprises at least one electric circuit 30 including a light-emitting arrangement 31 configured to emit anti-fouling light and a power-receiving arrangement 33 configured to receive power to be used for powering the light-emitting arrangement 31 from an external power-supplying arrangement 25 located on or near the surface 20. Further, the anti-fouling unit 1 comprises a carrier slab 40 carrying the at least one electric circuit 30 and having an emission surface 41. The power-receiving arrangement 33 is configured to allow positioning the anti-fouling unit 1 on the surface 20 in at least two distinct orientations both involving enablement of the power-receiving arrangement 33 to effective-

ly receive power from the external power-supplying arrangement 25. An advantage of the invention resides in the fact that it is possible to achieve that when an anti-fouling unit is to be placed on a certain portion of a surface 20, it is not necessary to bother about the orientation of the anti-fouling unit on that surface portion, as due to appropriate measures according to the invention, the power-receiving arrangement 33 of the at least one electric circuit 30 of the anti-fouling unit is enabled to effectively receive power from the external power-supplying arrangement 25 in the various possible orientations of the anti-fouling unit on the surface portion.

15 Claims

1. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) configured to be arranged on a surface (20), wherein the anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) comprises at least one electric circuit (30) including a light-emitting arrangement (31) configured to emit anti-fouling light and a power-receiving arrangement (33) configured to receive power to be used for powering the light-emitting arrangement (31) from an external power-supplying arrangement (25) located on or near the surface (20), and a plate-shaped carrier slab (40) carrying the at least one electric circuit (30), wherein the carrier slab (40) has an emission surface (41) configured to allow light from the light-emitting arrangement (31) of the at least one electric circuit (30) to pass to outside of the anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) and to thereby subject an exterior side of the emission surface (41) and surroundings thereof to an anti-fouling action, and wherein the power-receiving arrangement (33) is configured to allow positioning the anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) on the surface (20) in at least two distinct orientations both involving enablement of the power-receiving arrangement (33) to effectively receive power from the external power-supplying arrangement (25).
2. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to claim 1, wherein the difference between the at least two distinct orientations corresponds to a turn of the anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) on the surface (20) over at least 45°.
3. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to claim 1 or 2, wherein the periphery of the carrier slab (40) is of trapezoidal shape, square shape, rectangular shape, triangular shape or hexagonal shape.
4. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 1-3, wherein the power-receiving arrangement (33) comprises a single func-

tional power-receiving component (34) that is centrally arranged in the carrier slab (40).

5. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to claim 4, wherein the functional power-receiving component (34) is arranged to surround an area of the carrier slab (40) including the center of gravity of the carrier slab (40). 5
6. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to claim 4 or 5, wherein the single functional power-receiving component (34) is ring-shaped. 10
7. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 1-3, wherein the power-receiving arrangement (33) comprises at least two functional power-receiving components (34) configured to function independently from each other. 15
8. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to claim 7, wherein the carrier slab (40) has at least three straight sides, wherein at least one of the functional power-receiving components (34) is located at one of the straight sides of the carrier slab (40), and wherein at least one other of the functional power-receiving components (34) is located at at least one other of the straight sides of the carrier slab (40). 20
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9. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to claim 8, wherein the power-receiving arrangement (33) comprises at least as many functional power-receiving components (34) as the carrier slab (40) has straight sides, and wherein at least one functional power-receiving component (34) is located at each one of the straight sides. 30
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10. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 7-9, wherein the carrier slab (40) has a mirror symmetrical periphery, and wherein at least two functional power-receiving components (34) are located at mirror symmetrical positions in the carrier slab (40). 40
11. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 7-9, wherein the carrier slab (40) has a rotation symmetrical periphery, and wherein at least two functional power-receiving components (34) are located at rotation symmetrical positions in the carrier slab (40). 45
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12. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 7-9, wherein the carrier slab (40) has a rotation symmetrical periphery, and wherein at least two functional power-receiving components (34) are located at non-rotation symmetrical positions in the carrier slab (40). 55

13. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 4-12, wherein the single functional power-receiving component (34) or at least one of the at least two functional power-receiving components (34) comprises an electric coil.

14. Anti-fouling unit (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 1-13, wherein the at least one electric circuit (30) is embedded in the material of the carrier slab (40).

15. Assembly of an object and a plurality of anti-fouling units (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11) according to any of claims 1-14 arranged on a surface (20) of the object.

Fig. 1

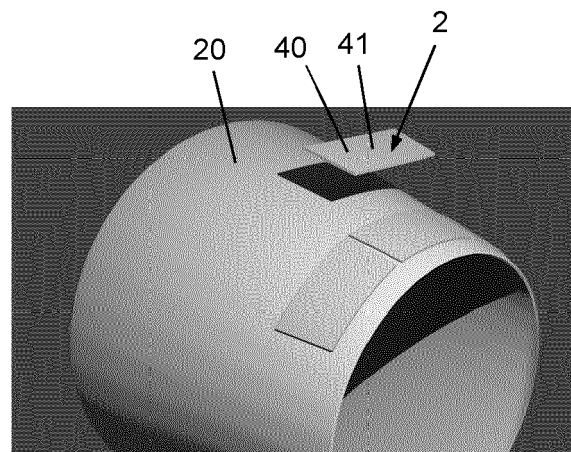
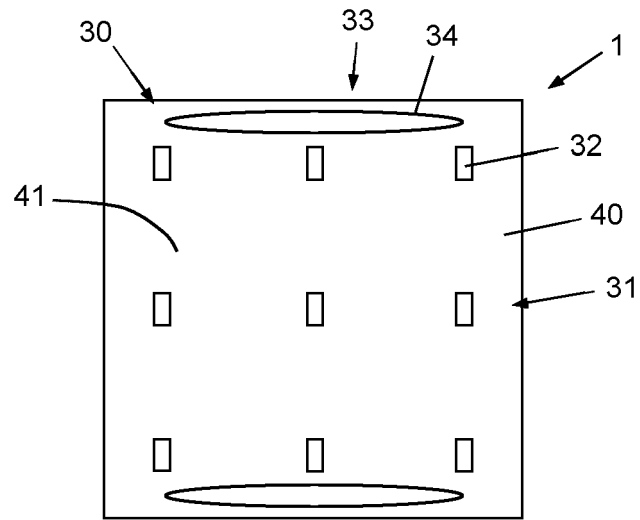


Fig. 2

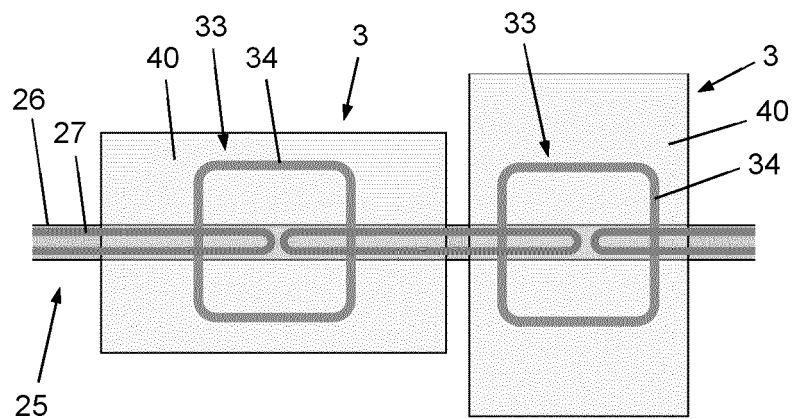


Fig. 3

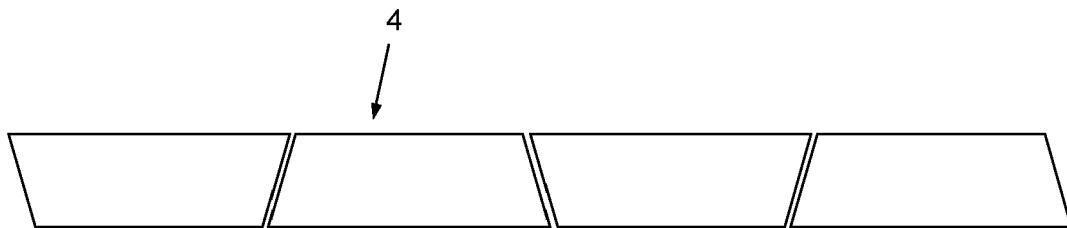


Fig. 4

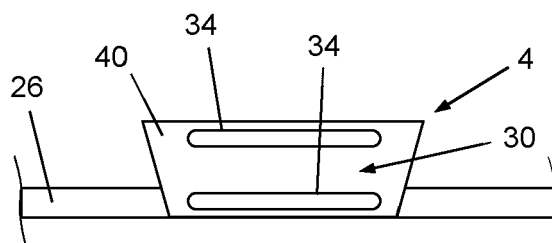


Fig. 5

Fig. 6

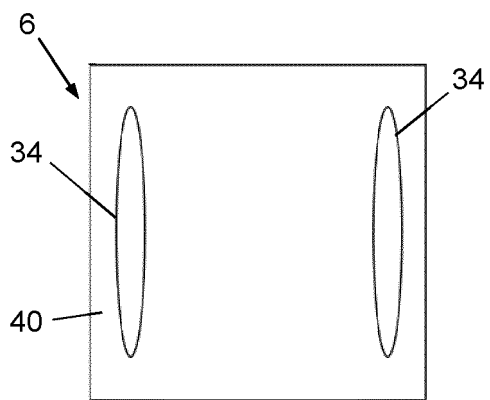
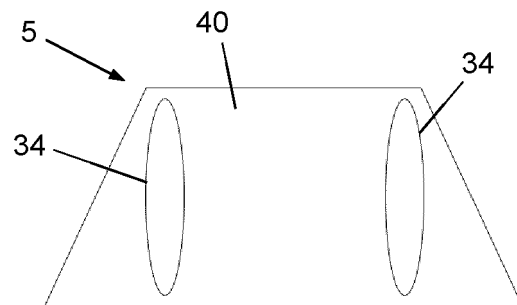


Fig. 7

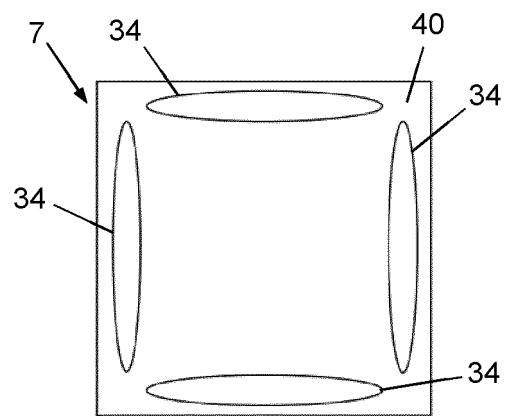


Fig. 8

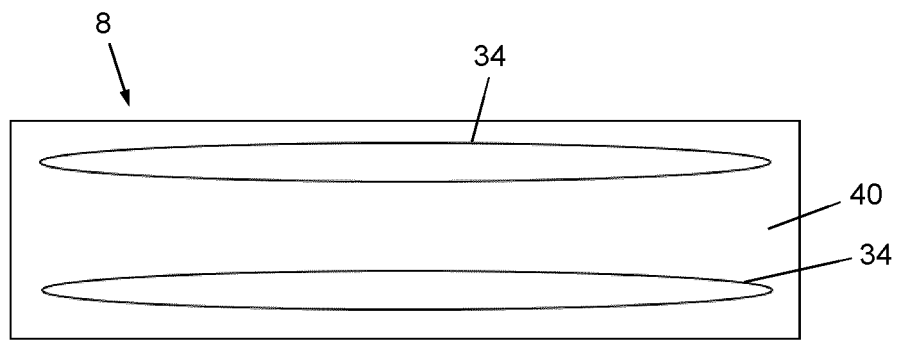


Fig. 9

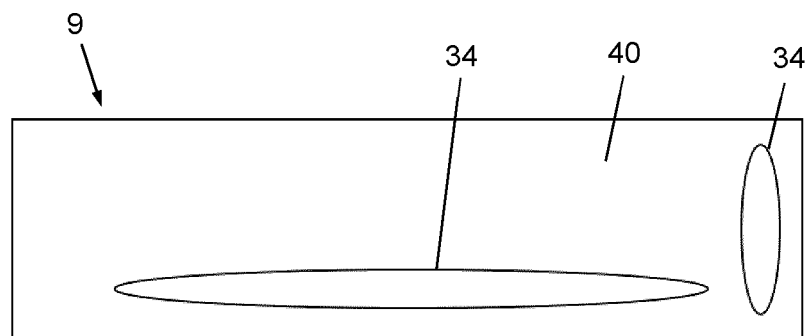


Fig. 10

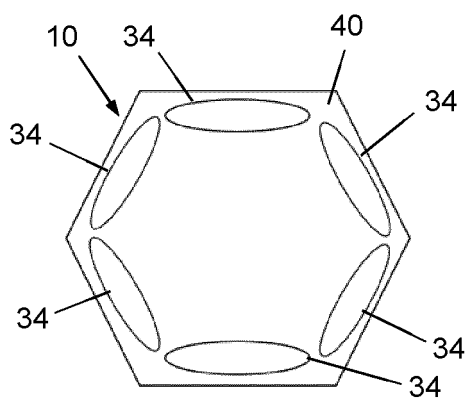


Fig. 11

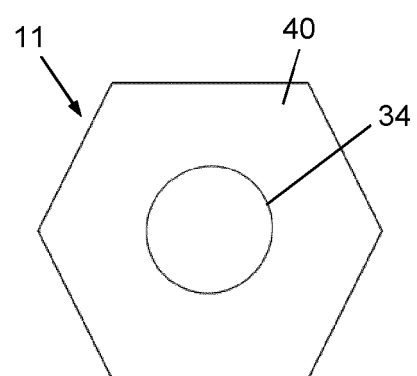


Fig. 12

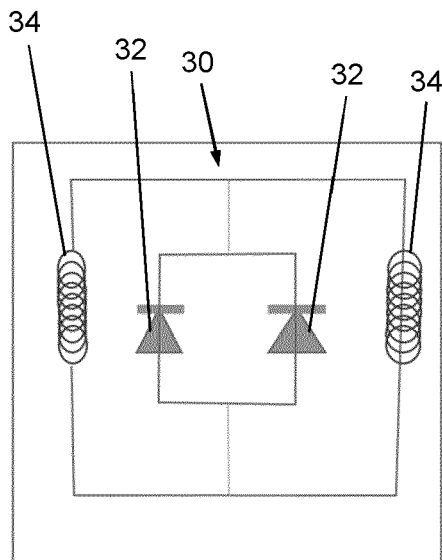


Fig. 13

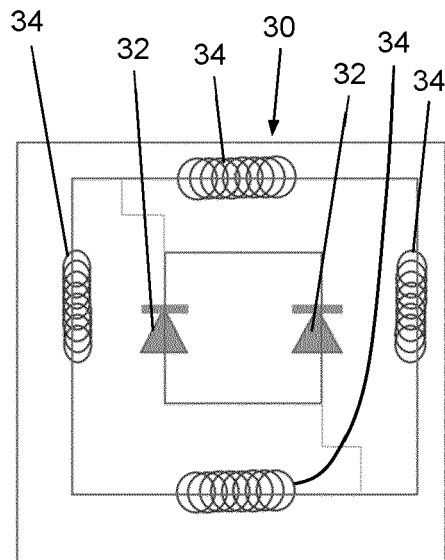


Fig. 14

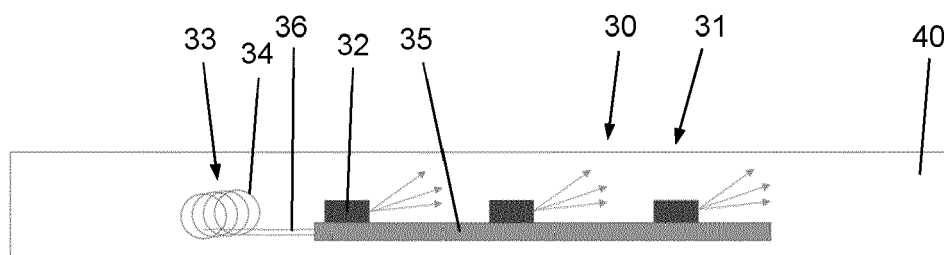


Fig. 15



EUROPEAN SEARCH REPORT

Application Number
EP 20 19 9843

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			B08B B63J B63B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 31 March 2021	Examiner Lang, Xavier
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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31-03-2021

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