

DEVICE FOR DISINFECTION OF CONTACT LENSES STORED IN A CASE

RELATED APPLICATIONS

This application claims priority to U.S. Patent Application Serial No. 13/118,931, filed May 31, 2011, and Provisional U.S. Patent Application Serial No. 61/357,786, filed on June 23, 2010.

FIELD OF USE

This invention describes a case for storing an ophthalmic lens and, more specifically, in some embodiments, a base for receiving a case with disinfecting functionality while storing an ophthalmic lens such as a contact lens.

BACKGROUND

Maintaining a clean environment during handling of a contact lens is generally considered essential to good ophthalmic health. One aspect of cleanliness that is often not adequately considered is a clean exterior of a contact lens case. Even if a contact lens handler conscientiously engages in hand-washing and proper use of lens solutions, the efficacy of such practices is limited if pathogens, such as bacteria and fungi may be present on the exterior of a contact lens case used to store the contact lenses.

Clean hands often come into contact with pathogens on the exterior of a contact lens case during the process of removing a top to a case to access a lens stored within the case. A result of such contact is that the previously clean hands now become contaminated with pathogens. During handling of the lens and placement of the lens onto the eye, contaminated hands may pass the pathogens on to a lens that has recently been disinfected with solution inside the storage case. The result is an increased risk of a pathogen being introduced into an area of the eye of the contact lens wearer.

Hydrogel contact lenses are very popular today. These lenses are often more comfortable to wear than contact lenses made of hard materials. Many hydrogel contact lenses may be worn for more than one day. A build-up of microbial life and

bacteria on the lenses during wear of the lens generally makes it desirable to periodically remove the lenses and disinfect them.

Disinfection of contact lenses traditionally entails placing the contact lens in a container or case and subjecting the contact lens to a chemical disinfectant. However, chemical disinfectants are not always as efficacious as may be desired. From time to time, a contact lens with a bacterium, mold, fungus or other type of adverse life form is reinserted into a user's eye with the result being a diseased eye. In addition, disinfecting solutions tend to be expensive and add to the total cost of using contact lenses for vision correction or cosmetic enhancement. New methods and approaches are therefore needed to disinfect contact lenses.

SUMMARY

Accordingly, the present invention includes a base for an ophthalmic lens storage case for storing reusable contact lenses and disinfecting the lenses during the storage and also disinfecting at least a portion of the lens storage case. The base is capable of generating disinfecting radiation to a surface of the storage case in a wavelength and intensity suitable to kill unwanted pathogens such as bacteria, viruses, molds, fungi and the like on the lens case.

In addition, in some embodiments, the base provides vibrational frequency mechanically sufficient to effectively dislocate expired microbials and provide increased exposure of unexpired microbials to life extinguishing radiation.

In another aspect, in some embodiments, a disinfecting radiation base includes one or more reflective surfaces, such as a mirror, for reflecting disinfecting radiation towards an ophthalmic lens storage case mounted in the disinfecting radiation base.

DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a lens storage case in a base unit according to some embodiments of the present invention.

FIG. 2 illustrates some embodiments of alignment of a disinfecting radiation source with an ophthalmic lens in a lens storage case according to the present invention.

FIG. 3 illustrates a close up view of a storage case with one cap removed according to some embodiments of the present invention.

FIG. 4 illustrates aspects of a base unit according to some embodiments of the present invention.

5 FIG. 5 illustrates a base unit in a closed state with a display.

FIG. 6 illustrates a prior art contact lens storage case in a soiled condition.

DETAILED DESCRIPTION OF THE INVENTION

The present invention includes methods and apparatus for disinfecting a surface of an ophthalmic lens storage case. In addition, the present invention includes a
10 storage case for holding an ophthalmic lens while one or both of the lenses and the surface of the lens storage case is disinfected with disinfecting radiation.

In the following sections detailed descriptions of embodiments of the invention will be given. The description of both preferred and alternative embodiments are exemplary embodiments only, and it is understood that to those skilled in the art that
15 variations, modifications and alterations may be apparent. It is therefore to be understood that said exemplary embodiments do not limit the scope of the underlying invention.

GLOSSARY

20 In this description and claims directed to the presented invention, various terms may be used for which the following definitions will apply:

Disinfecting Radiation: as used herein refers to a frequency and intensity of radiation sufficient to diminish the life expectancy of a life form receiving a Disinfecting Radiation Dose.

25 Disinfecting Radiation Dose: as used herein refers to an amount of radiation to reduce an amount of pathogen life by at least two logs on a logarithmic scale and preferably three logs or more, wherein life includes at least bacteria, viruses, molds and fungi.

Lens: refers to any ophthalmic device that resides in or on the eye. These
30 devices can provide optical correction or may be cosmetic. For example, the term lens can refer to a contact lens, intraocular lens, overlay lens, ocular insert, optical insert or

other similar device through which vision is corrected or modified, or through which eye physiology is cosmetically enhanced (e.g. iris color) without impeding vision. In some embodiments, the preferred lenses of the invention are soft contact lenses made from silicone elastomers or hydrogels, which include but are not limited to silicone hydrogels, and fluorohydrogels.

Referring first to Fig. 6, an example of a contact lens storage case 600 including a storage case lens holder 601 and a storage case lid 602, is illustrated. As illustrated, in some instances a contact lens storage case 600 may accumulate significant soiling and pathogen build-up 603 on one or more surfaces of the storage case 100.

Referring now to Fig. 1, an ophthalmic lens disinfecting system 100 is illustrated including a radiation based disinfecting base 101, a radiation based disinfecting storage case 102 and one or more disinfecting radiation sources 103-104. The radiation based disinfecting storage case 102 may include a storage case lid and a storage case holder. According to the present invention, a radiation based disinfecting storage case 102 is positioned within the path of radiation from the one or more disinfecting radiation sources 103-104, such that one or both of the surface of a radiation based disinfecting lens storage case 102 and ophthalmic lenses (not illustrated) stored within the disinfecting storage case 102 are exposed to radiation emanating from the one or more disinfecting radiation sources 103-104 and pathogens existing on, or in proximity to, radiation based disinfecting lens storage case 102 are exposed to disinfecting radiation provided by a disinfecting radiation source 103-104, and killed, essentially disinfecting one or both of the ophthalmic lens and a surface of the lens storage case.

As illustrated, the ophthalmic lens disinfecting system 100 including a generally clamshell type configuration, is positioned in an open state with a radiation disinfecting base 101 and a lid 106. A radiation disinfecting storage case 102 is shown positioned in the clamshell radiation disinfecting storage system 100. In some preferred embodiments, the radiation disinfecting storage case 102 includes a positioning artifact 105 for aligning the disinfecting radiation source 103 with the radiation disinfecting storage case 102. As illustrated, the positioning artifact 105 includes an annular depression for receiving an annular arrangement of disinfecting radiation source 103. Positioning artifacts 105 may include almost any polygon

shaped depression. Other embodiments may include one or more alignment pins. In still other embodiments, a positioning artifact 105 may include a snap, a threaded joining or other removably fixed type of joining.

5 In some embodiments, the positioning artifact 105 aligns the radiation disinfecting radiation source 103-104 in a position generally orthogonal to a top surface of a storage case 102 placed in the ophthalmic lens disinfecting system 100. In additional embodiments, a positioning artifact 105 aligns the radiation disinfecting radiation source 103 in a position generally orthogonal to a plane of a storage case 102 placed in the ophthalmic lens disinfecting system 100.

10 In another aspect, in some embodiments, the radiation disinfecting base 101 may also include a source of a vibrational frequency 106 capable of transmitting a vibrational frequency from a radiation disinfecting base 101 to the radiation disinfecting storage case 102 and ultimately to a lens stored within the radiation disinfecting storage case 102.

15 In some preferred embodiments, the vibrational frequency may be a frequency capable of causing expired life forms to be moved from within a path of radiation to an unexpired life form. Moving the expired life forms allows for more efficacious disinfecting by exposing more unexpired life forms to a direct path of radiation.

The one or more radiation disinfecting radiation source 103-104 may include
20 one or more light emitting diodes (LEDs). In some preferred embodiments, the LEDs include ultraviolet (UV) emitting LEDs. Preferred embodiments include LEDs which emit light radiation with a wavelength of between about 250 nanometers of light radiation and about 280 nanometers of light radiation, preferably, the wavelength is between 250 nanometers and 275 nanometers, and most preferably 254 nanometers.

25 Referring now to Fig. 2, a block diagram illustrates some embodiments of alignment of a radiation disinfecting source 200, such as one or more UV LEDs radiating disinfecting radiation 202 in the UV spectrum towards a contact lens storage case 201. In some preferred embodiments, UV LEDs will be arranged such that a radiation disinfecting storage case will align in a specific position in relation to the
30 contact lens storage case 201. The alignment is maintained via an alignment artifact.

In some embodiments, a radiation disinfecting storage case is aligned to direct UV radiation 202 at an angle essentially orthogonal to a plane 203 plane across a top portion of the contact lens storage case 201.

In other embodiments, radiation disinfecting storage case may be aligned to direct disinfecting radiation 202A from one or more UV emitting LEDs 200A at an angle essentially orthogonal to a plane 205 across a bottom of the contact lens storage case 201.

5 In another aspect, in some embodiments, one or more optics 204 may be used to focus disinfecting radiation onto a disinfecting radiation storage case 201. An optic may be included in a base or in a part of a storage case.

Referring now to Fig. 3, an exemplary radiation disinfecting storage case 300 is illustrated. The radiation disinfecting storage case 300 includes one or more lens
10 storage compartments 301. A storage compartment 301 is capable of receiving and storing one or more ophthalmic lenses, such as a contact lens.

Some embodiments include one or more lens alignment mechanisms 302 for positioning an ophthalmic lens stored in a storage compartment 301 included in a radiation disinfecting storage case 300. A lens alignment mechanism 302 may include
15 for example a pedestal with an arcuate surface generally of a similar size and shape as an inside dimension of an ophthalmic lens. A convex surface may include an arc generally equivalent to an arc of a concave surface of an ophthalmic lens to be stored within the radiation disinfecting storage case 300. Other embodiments may include a lens alignment mechanism 306 comprising a bowl generally of a similar size and shape
20 as an outside dimension of an ophthalmic lens.

Preferred positioning aligns the stored lens in a direct path of disinfecting radiation. However, other embodiments may include one or reflective surfaces 306. A reflective surface 306 may essentially include a mirror and be formed from a glass, a plastic, a metal or a coating that is functional to reflect disinfecting radiation in a
25 direction desired. Generally, the direction will be towards a lens stored in a storage case 300 positioned in the base. In some embodiments, reflective surface 306 may be generally proximate to, and/or generally parallel to, a surface of a stored lens. Other embodiments may include a reflective surface 306 generally around a perimeter of a stored lens.

30 One or more radiation windows 303-304 are included in the storage compartments 301. The radiation windows 303-304 provide portions of the radiation disinfecting storage case that are at least partially transparent to wavelengths of disinfecting radiation. Preferably the radiation windows 303-304 will be as close to

100% transparent as possible to disinfecting radiation transmitted into the storage compartment 301. Plastics that are injection moldable may be 90 % or more or even 98% or more transparent to UV radiation. Specific wavelengths may include between about 254 nanometers to 280 nanometers.

5 In some embodiments, a radiation window may also include an optic for directing disinfecting radiation towards areas of an ophthalmic lens stored in the stored compartment 301.

 Examples of materials from which the radiation windows 303-304 may be formed include, for example: cyclic olefins, TOPAS, ZEONOR or other injection
10 moldable plastic. Other plastics or glass may also be utilized as a material for the radiation window 303-304. The area of the radiation windows 303-304 should be sufficient to admit enough disinfecting radiation into the storage compartments to kill life forms present on an ophthalmic lens stored in the storage compartment 301.

 Some preferred methods of manufacture of a radiation disinfecting storage case
15 include injection molding processes. Other methods include, for example, lathing, stereo lithography, and three dimensional printing.

 In another aspect, radiation disinfecting storage case 300 may include a fastening mechanism 305A-305B for securing and removing a cap 306 from a storage compartment 307. The fastening mechanism 305A-305B may include a threaded
20 portion, a snap, and a tapered joint of other mechanism for removably securing the cap 308 to the case at the discretion of the user. While the cap 308 is secured to the storage compartment 307, the cap seals off an ambient atmosphere from the storage compartment 307 and also contains an ophthalmic lens and, in some embodiments, a solution, such as, for example a saline solution, within the compartment 307.

25 Referring now to Fig. 4, a radiation disinfecting base unit 400 is illustrated with multiple disinfecting radiation source LEDs 401-402. As illustrated, the disinfecting radiation source LEDs 401-402 may include one or both of overhead disinfecting radiation source LEDs 401 and lower disinfecting radiation source LEDs 402. In addition to the overhead disinfecting radiation source LEDs 401 and lower disinfecting
30 radiation source LEDs 402, the base unit may include a processor board 403 with control electronics for controlling various aspects associated with the radiation disinfecting base 400.

The processor board 403 may be coupled to a digital storage 408. The digital storage may include executable software that is executable upon command or automatically upon operation of the radiation disinfecting base unit 400. The digital storage 408 may also store data related to operation of the radiation disinfecting case 400. Operational data may include for example, time periods during which a radiation disinfecting base unit 400 is operated; serial numbers of lenses being disinfected; a period of time that a lens has been placed in use, or other information. In some embodiments, a radiation disinfecting base unit 400 may include a scanner 409 or other input means to input an identification number associated with a lens stored in a radiation disinfecting base unit 400. For example, the scanner 409 may scan a bar code or other symbol on a lens package and log disinfecting information associated with the bar code number or symbol. Information that may be logged may include for example, a number of hours that a lens has been exposed to disinfecting radiation and a number of days that a lens has been placed into use.

An electrical communication connector 404 may also be included in the radiation disinfecting base unit 400. The electrical communication connector 404 may include a universal serial bus (USB) connector or other type of connector. The connector may include a terminal for transferring one or both of data and electrical power. In some embodiments, the electrical communication connector 404 provides power to operate the radiation disinfecting base unit 400. Some embodiments may also include one or more batteries 405 or other power storage device. In some preferred embodiments, the batteries 405 include one or more lithium ion batteries or other rechargeable device. The power storage devices may receive a charging electrical current via the electrical communication connector 404. Preferably, the radiation disinfecting base unit 400 is operational via stored power in the batteries 405.

In some embodiments, the electrical communication connector 404 may include a simple source of AC or DC current.

In another aspect, the present invention may include a source of mechanical movement, such as a vibration generation device 406. The vibration generation device 406 may include, for example, a piezoelectric transducer. A piezoelectric transducer offers a low power reliable device to provide mechanical or vibrational movement.

In some embodiments, the vibrational movement will be adjusted to a frequency that effectively moves dead organisms stored within a storage case in the

radiation disinfecting base unit 400. Movement of the dead organisms exposes live organisms that may have otherwise been sheltered from disinfecting radiation.

In still another aspect, in some embodiments, the processor board 403 or other electronic circuitry may control a pattern of light or radiation emitted by the disinfecting radiation source LEDs 401-402. The pattern may include, for example, strobes of a set frequency or variable frequencies.

Some embodiments may also include a display 407. The display 407 will be in logical communication with the processor board 403 and be used to communicate, in human readable form, data relating to the operation of the radiation disinfecting base unit 400.

In another aspect, in some embodiments, one or more UV sensors 410 may monitor an amount of UV radiation present and provide input into a feedback loop that controls an output from disinfecting radiation source LEDs 401-402. Some embodiments include one or more UV sensors 410 that receive UV radiation after the UV radiation has passed through one or more of a lens storage case and a stored lens.

Use of a UV sensor 410 feedback accommodates LEDs that may emit decreasing radiation over the life of the LED and also accommodate different lens storage cases that may differ in transparency characteristics from one case to another.

Referring now to Fig. 5, a radiation disinfecting base unit 500 is illustrated in a closed position. A radiation disinfecting base 501 is covered by a lid 502, in the illustrated embodiments; the lid 502 is hinged to the radiation disinfecting base 501 and folds over on top of the radiation disinfecting base 501. Other embodiments are also within the scope of the invention. As illustrated, a display 503 is located in the lid 502 and may provide an indication of a disinfecting cycle or procedure being executed by the radiation disinfecting base unit 500.

Conclusion

The present invention, as described above and as further defined by the claims below, provides apparatus for disinfecting an ophthalmic lens.

CLAIMS

1. A base for receiving an ophthalmic lens storage case for storing one or more
5 ophthalmic lenses, the base comprising:
a receptacle for receiving an ophthalmic lens storage case; and
a source of disinfecting radiation providing disinfecting radiation to
surface of the ophthalmic lens storage case.
- 10 2. The base of claim 1 additionally comprising a reflective surface for reflecting
disinfecting radiation towards ophthalmic lens storage compartment.
3. The base of claim 1 additionally comprising a sensor capable of sensing an
amount of disinfecting radiation and a feedback loop capable of controlling an
15 amount of radiation emitted by the source of disinfecting radiation.
4. The base of claim 1 source of disinfecting radiation comprises one or more
electronic components.
- 20 5. The base of claim 4 wherein at least some of the one or more electronic
components is aligned above a cap comprising a lens storage case.
6. The base of claim 5 wherein at least some of the one or more electronic
components is aligned below a lens holder comprising a lens storage case.
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7. The base of claim 6 wherein the one or more sources of disinfecting radiation
comprise an ultraviolet emitting diode.
8. The base of claim 7 wherein the ultraviolet emitting diode emit radiation in a
30 frequency of between 250 nanometers and 280 nanometers.
9. The base of claim 1 wherein the emitted disinfecting radiation is sufficient kill
an organism on surface of the ophthalmic lens storage case.

10. The base of claim 1 additionally comprising an optic for directing disinfecting radiation towards the ophthalmic lens storage case.
- 5 11. The base of claim 1 additionally comprising a processor for controlling the generation of disinfecting radiation.
12. The base of claim 11 wherein a time period that a disinfecting radiation is provided is based upon a logical control signal generated by the processor.
- 10 13. The base of claim 11 wherein an intensity at which a disinfecting radiation is provided is based upon a logical control signal generated by the processor.
14. The base of claim 11 additionally comprising an audio component operative to provide an audio signal based upon operation of the source of disinfecting radiation.
- 15 15. The base of claim 11 additionally comprising a display for displaying a status of a disinfecting process based upon digital data transmitted by the processor.
- 20 16. The base of claim 11 additionally comprising a digital storage for storing information related to a disinfecting process.
17. The base of claim 1 additionally comprising a vibration generation device for providing mechanical movement to a storage case placed in the storage base.
- 25 18. The base of claim 17 wherein the vibration generation device comprises a piezoelectric mechanism.
- 30 19. The base of claim 17 wherein the piezoelectric mechanism is operated based upon a logical signal generated by a processor.

20. The base of claim 16 additionally comprising a universal serial bus connector for providing logical communication between one, or both of: the processor and the digital storage; and personal processing device.
- 5 21. The base of claim 16 additionally comprising a universal serial bus connector for providing an electrical current for operating the storage base.
22. The base of claim 1 additionally comprising an electrical storage for storing power to operate the storage base.
- 10 23. The base of claim 22 wherein the electrical storage comprises one or more rechargeable batteries.
24. The base of claim 23 wherein the electrical storage comprises one or more lithium ion batteries.
- 15 25. The base of claim 12 wherein a pattern of radiation is based upon a signal from the processor.

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