INTRAOCULAR LENS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to intraocular lenses, and intraocular lenses capable of modification after implantation in the eye, and more particularly, to an intraocular lens or corneal lens using an annular Fresnel lens.

2. Description of the Prior Art

None of the prior art lenses known to the applicant have utilized the Fresnel lens configuration. None of the prior art lenses known to applicant have utilized composite material in a lens which electroptically changes the index of refraction.

The present invention provides a composite lens with material which electroptically changes the index of refraction. Also, the composite lens can include piezo electric material in the loops to control the material. Further, the composite lens can also include a Fresnel lens structure.

SUMMARY OF THE INVENTION

The general purpose of the present invention is to provide an intraocular lens or corneal lens incorporating an annular Fresnel lens.

According to one embodiment of the present invention, there is provided an anterior chamber lens or posterior chamber lens, including loops for supporting the intraocular lens in the anterior or posterior chamber, which includes an annular Fresnel lens.

In another embodiment of the present invention, there is provided a corneal inlay, the corneal lens including an annular Fresnel lens.

Still another embodiment of the present invention includes an intraocular lens having an annular Fresnel lens and a composite overlay which has an index of refraction alterable by radiant energy or like application of electrical energy from an electromagnetic source outside of the eye. The composite overlay changes refraction due to pressure on the material by loops in contact with the capsular bag.

One significant aspect and feature of the present invention is an intraocular lens or corneal inlay which refracts, condenses, and parallels the light rays in all planes in accordance with Fresnel lens principles. The lens also focuses the image on the retina directly, or, in the case of the intracorneal inlay, focuses on the natural crystaline lens which can then still accommodate incident light to focus on the retina, or if the natural crystaline lens has been removed as in the aphacic the intracorneal inlay lens can focus directly on the retina.

Having thus described embodiments of the present invention, it is a principal object hereof to provide an intraocular lens or corneal inlay having an annular Fresnel lens.

One object of the present invention is to provide an intraocular lens with an annular Fresnel lens. The intraocular lens has loops attached for facilitating mounting in either the anterior or posterior chamber of the eye.

Another object of the present invention is to provide a corneal lens having an annular Fresnel lens.

A still further object of the present invention is to provide an intraocular lens or corneal inlay having a composite element, the index of refraction of which can be altered by the application of radiant energy or electrical energy from a power source outside the eye. In the application of an intraocular lens, pressure placed on the loops may change the index of refraction of the lens through piezo electric material composite in the loops. The composite material can be used with a Fresnel lens structure or any other lens structure such as a meniscus optic, bi-convex, plano-convex, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a top view of an anterior chamber intraocular lens including an annular Fresnel lens;

FIG. **2** illustrates a side view of the lens shown in FIG. **1**;

FIG. **3** illustrates a cross-sectional view of the lens shown in FIG. **1** taken along lines **3**—**3** of FIG. **1**;

FIG. **4** illustrates a top view of a posterior chamber intraocular lens including an annular Fresnel lens;

FIG. **5** illustrates a side view of the lens shown in FIG. **4**;

FIG. **6** illustrates a cross-sectional view of the lens shown in FIG. **5** taken along lines **6**—**6** of FIG. **4**;

FIG. **7** illustrates a corneal inlay with an annular Fresnel lens;

FIG. **8** illustrates a side view of a corneal inlay with an annular Fresnel lens;

FIG. **9** illustrates a cross-sectional view of the lens shown in FIG. **7** taken along lines **9**—**9** of FIG. **7**; and,

FIG. **10** illustrates a top view of an alternative embodiment with piezo electric material; and

FIG. **11** illustrates a side view of FIG. **10**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** illustrates an intraocular lens **10** of the present invention, including a Fresnel annular lens optic **12** and two vaulted loops **14** and **16** secured with the lens optic **12**. The loops can be any desirable shape and can be vaulted. The loops and lens optic can be made of any suitable material such as PMMA or polysulfone. The optic can be plano-convex, bi-convex, or convex-concave.

FIG. **2** illustrates a side view of the lens shown in FIG. **1**. The lens optic **12** includes a Fresnel lens having a plano-convex central portion **18**, as also shown in FIG. **3**, and a plurality of concentric Fresnel rings **20*a*-20*n*** with centers of curvature varying in accordance with the radial distance from the center of central portion **18**, so as to eliminate spherical aberration. A composite overlay material **22**, of clear compound, provides a smooth surface to protect the top edges of rings **20*a*-20*n***, and therefore, the eye from the sharp edges, or can also be used as a modifying system of minimizing or maximizing the index of refraction of the Fresnel or other lens of the composite. The overlay **22** is not required for operation of the lens in the eye since loops **14** and **16** position the lens optic away from the interior surfaces of the eye. The lens can be provided as a plus or minus lens.

FIG. **3** illustrates a cross-sectional view of the lens of FIG. **1** taken along lines **3**—**3** where all numerals correspond to those elements previously described. The overlay **22** includes a material **24** having an index of refraction which is alterable by the application of an electric field or electromagnetic radiation. This material, which can be a liquid crystal material or crystalline lattice, provides a change in the index of refraction, and therefore, also the power of the lens. The index of refraction can be variable dependent on the magnitude of