INTRAOCULAR LENS IMPLANT HAVING EYE ACCOMMODATING CAPABILITIES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is broadly concerned with improved intraocular lenses which can be surgically implanted as a replacement for the natural crystalline lenses in the eyes of cataract patients. More particularly, the invention is concerned with such intraocular lenses which have a specially configured, resilient optic positioning element serving to maintain the equatorial segment of the positioning element in substantial contact with the corresponding equatorial portion of the capsule of the eye.

2. Description of the Prior Art

Cataracts occur when the crystalline lens of the eye becomes opaque. The cataracts may be in both eyes and, being a progressive condition, may cause fading vision and eventual blindness. Cataracts were once surgically removed along with the anterior wall of the capsule of the eye. The patient then wore eyeglasses or contact lenses which restored vision but did not permit accommodation and gave only limited depth perception.

The first implant of a replacement lens within the eye occurred in 1949 and attempted to locate the replacement lens in the posterior chamber of the eye behind the iris. Problems such as dislocation after implantation forced abandonment of this approach, and for some period thereafter intraocular lenses were implanted in the anterior chamber of the eye.

Others returned to the practice of inserting the lens in the area of the eye posterior to the iris, known as the posterior chamber. This is the area where the patient's natural crystalline lens is located. When the intraocular lens is located in this natural location, substantially normal vision may be restored to the patient and the problems of forward displacement of vitreous humor and retina detachment encountered in anterior chamber intraocular lenses are less likely to occur. Lenses implanted in the posterior chamber are disclosed in U.S. Pat. Nos. 3,718,870, 3,866,249, 3,913,148, 3,925,825, 4,014,049, 4,041,552, 4,053,953, and 4,285,072. None of these lenses have focusing capability.

Lenses capable of focusing offered the wearer the closest possible substitute to the crystalline lens. U.S. Pat. No. 4,254,509 to Tennant discloses a lens which moves in an anterior direction upon contraction of the ciliary body located anterior to the iris. Though providing focusing capabilities, it presents the same disadvantages as other anterior chamber lenses. U.S. Pat. No. 4,253,199 to Banko approaches the problem of providing a focusable lens differently, by providing a replacement lens of deformable material sutured to the ciliary body. This lens functions much as the original crystalline lens but risks bleeding from the sutures.

U.S. Pat. No. 5,674,282 to Cumming is directed towards an accommodating intraocular lens for implanting within the capsule of an eye. The Cumming lens comprises a central optic and two plate haptics which extend radially outward from diametrically opposite sides of the optic and are movable anteriorly and posteriorly relative to the optic. However, the Cumming lens suffers from the same shortcomings as the Levy lens in that the haptics are biased anteriorly by pressure from the ciliary bodies. This will eventually lead to pressure necrosis of the ciliary body.

Finally, U.S. Pat. No. 4,842,601 to Smith discloses an accommodating intraocular lens having anterior and posterior members which urge against the anterior and posterior walls of the natural lens capsule. The muscular action exerted on the natural capsule will thus cause the lens to flatten, thereby changing the focus thereof. The Smith lens is formed of first and second plastic lens members connected to one another adjacent their peripheral edges so as to provide a cavity therebetween. The connection between the lens members is accomplished by way of a U-shaped flange on the first member which forms an inwardly facing groove for receiving an outwardly extended flange on the second member. The Smith lens is lacking in that the first and second members must be separately inserted into the capsule and assembled within the capsule which is extremely difficult for even highly skilled surgeons to accomplish.

SUMMARY OF THE INVENTION

The present invention represents a significant advance in the art and provides an accommodating intraocular lens for implantation substantially within the confines of the capsule of the human eye between the anterior and posterior capsule walls. The lens comprises a single optic presenting opposed anterior and posterior surfaces, together with a resilient optic positioning element coupled to the optic to cooperatively present a shape that generally conforms to the shape of the capsule. The optic positioning element has a posterior face configured for yieldable engagement with the posterior capsule wall, and an anterior face configured for yieldable engagement with the anterior wall of the capsule. The positioning element also defines an equatorial segment of maximum diameter between the anterior and posterior faces. The positioning element is operable to substantially maintain the equatorial segment thereof in contact with at least a part of the capsule equatorial portion in essentially all orientations and conditions of accommodation of the lens within the capsule.

The positioning element is preferably formed of a yieldable synthetic resin material to present a unitarily formed, seamless body having an elastic memory. In practice, the lens of the invention is surgically implanted within a capsule, so as to take full advantage of the "rubber band effect." This in turn assures accurate lens accommodation in response to contraction and relaxation of the ciliary body, acting through the zonules and the elastin tissue of the eye.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a generally schematic vertical sectional view of an intraocular lens in accordance with the invention, shown mounted in the capsule of an eye;

FIG. **2** is a view similar to that of FIG. **1**, but illustrating the intraocular lens in an accommodated position owing to relaxation of the ciliary muscle;

FIG. **3** is a plan view of a preferred lens of the invention;

FIG. **4** is a vertical sectional view taken along line **4**—**4** of FIG. **3** and further illustrating the construction of the intraocular lens;

FIG. **5** is a top perspective view of the lens of FIG. **3**;

FIG. **6** is a bottom perspective view of the lens of FIG. **3**;

FIG. **7** is an enlarged, fragmentary view of another embodiment in accordance with the invention, including a thin membrane in covering relationship to openings present in the optic positioning element to impede migration of cells therethrough; and

FIG. **8** is a vertical sectional view taken along line **8**—**8** of FIG. **7** and further depicting the construction of the FIG. **7** embodiment.