INTRAOCULAR LENS DEVICE

This invention relates to an improved lens device which can be implanted intraocularly when defects occur such as permanent loss of corneal clarity, or loss of clarity of the natural lens due to cataract, and replace intraocular volume when the natural lens is extracted.

Various types of intraocular implant lens devices have been proposed, and surgical procedures for their insertion into the eye have been developed. Examples of such prior devices may be found in U.S. Pats. Nos. 3,866,249, 3,711,870, 3,673,616 and 2,834,023; but, to the best of our knowledge, no intraocular lens implant device has been developed which has a good record of patient tolerance. Some of the problems encountered with such prior devices are discussed in the introductory portion of the above-mentioned U.S. Pat. No. 3,866,249, to which reference is made, and in general, it seems that these problems with prior devices stem from the materials employed in their construction and from the means used for fixing them within the intraocular tissues.

The intraocular lens device of the present invention is made of a transparent, flexible, medical grade, silicone elastomer formed into a generally cylindrical lens body having a desired refractive power and a marginal portion adapted to be fitted within the pupillary margin of the iris; means for the fixation of the lens device to the iris including flexible plate-like tab means comprising flaps formed of the silicone material and projecting outwardly from the marginal portion of the lens body for placement in overlapping relation with at least one of the anterior and posterior surfaces of the iris; and means for attaching said flexible tab means to the iris.

The silicone elastomer provides a material that is inert and has been successfully used in multiple applications around the body; e.g., extraocular, intravascular, intracardiac, etc. When employed with the lens construction of the invention, the result is to provide an intraocular lens device which is reasonably inert, very light in weight, and flexible; and, all of these features minimize the possibility of post-operative complications which experience shows have been primarily due to irritation of the intraocular tissues by the implanted device.

Various arrangements may be employed for the flexible plate-like fixation tabs which may be molded in one piece with the lens body portion of the device or which may be separately attached to the lens body, as desired.

The foregoing and other features and advantages of the invention will appear from the following description of the representative embodiments thereof shown in the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional elevation of the human eye with an intraocular lens device of the invention implanted therein;

FIG. **2** is a plan view of one form of lens device of the invention;

FIG. **3** is a side elevation of the device shown in FIG. **2**;

FIG. **4** is a plan view of an alternate form of the lens device of the invention;

FIG. **5** is a side elevation of the device shown in FIG. **4**;

FIG. **6** is a plan view illustrating another form of lens device of the invention;

FIG. **7** is a side elevation of the device shown in FIG. **6**;

FIG. **8** is a plan view of a further form of lens device of the invention;

FIG. **9** is a side elevation of the device shown in FIG. **8**;

FIG. **10** is a plan view of another alternate form of lens device of the invention;

FIG. **11** is a plan view of a further alternate construction of the lens device of the invention;

FIG. **12** is a side elevation of the device of FIG. **11**, taken in the direction of the arrow **12**;

FIG. **13** is a side elevation of the device of FIG. **11**, taken in the direction of the arrow **13**;

FIG. **14** is a plan view of another alternate construction of the lens device of the invention;

FIG. **15** is a side elevation of the device of FIG. **14**; and,

FIG. **16** is a side elevation of a further alternate construction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** illustrates, somewhat schematically, the major components of the outer portion of an eyeball or globe **10**. These portions include the cornea **12**, the sclera **14**, the limbus **16** and the iris **18** which extends from the ciliary body **20** and which includes the circular pupillary margin **22**. A natural lens **24** is indicated in broken line and is normally attached to the ciliary body **20**. The iris **22** and the natural lens **24** normally divide the interior of the eye into an anterior chamber **26** filled with aqueous humor and a posterior chamber **28** filled with the vitreous body **30** covered by the hyaloid membrane **32**.

The natural lens **24** of the eye **10** has been removed and replaced by an intraocular lens device **34** constructed in accordance with the present invention and shown in FIGS. **2** and **3**. A generally cylindrical lens body **36** is formed with a desired refractive power and includes a cylindrical marginal portion **38** adapted to be fitted within the pupillary margin **22** of the iris **18**. Both the anterior and posterior surfaces of the lens body **36** can be used to provide the optical power desired. Means **40** for the fixation of the device **34** to the iris **18** include pairs of anterior and posterior flexible tabs **41** and **42** which project outwardly from the marginal portion **38** of the lens body **36** and are adapted to be placed, respectively, in overlapping relation with the anterior and posterior surfaces **43** and **44** of the iris **18**. Aligned apertures **46** are formed in each pair of tabs **41** and **42**, and a headed peg **48** is adapted to be inserted through the apertures **46** and through the iris tissue, thereby attaching the flexible tabs to the iris.

The lens body **36** and the tabs **41** and **42** are made from a silicone elastomer, preferably one of medical grade which can be sterilized. This material is light in weight, is transparent, is flexible, and is inert, being non-irritating and not affected by body fluids. This material also preferably has a refractive index slightly higher than the aqueous humor of the eye.

A molding technique is preferably used for forming the lens body **36**, and the molding process may also include the formation of the tabs **41** and **42**, although a corresponding tab of each pair may be formed separately and then bonded to the lens body **36** in order to