ACCOMMODATING INTRAOCULAR IMPLANT

TECHNICAL FIELD

This invention relates to intraocular lenses and more particularly to an accommodating intraocular lens.

BACKGROUND ART

Over the past two decades, operation techniques and lens structures have been developed which, when suitably handled, restore vision to eyes blinded by cataracts. In general, the development of such lenses and the surgical techniques involved in connection with such lenses are described in Applicant's book entitled *A Lens for All Seasons,* Tennant, Dallas, Tex. 1976. Such lenses have been extensively used with great success. Briefly described, Applicant's prior lens system as set forth in the above publication is a unitary structure having an optical lens anteriorly convex and posteriorly planar with two diametrically opposed pairs of coplanar feet extending away from the lens. Two supporting members forming an arch are included in the unitary structure and couple the lens to the feet outside the perimeter of the lens and support the lens with the posterior thereof anterior to the plane of the feet.

There exists a need for structure which more closely conforms with the action of the natural eye, particularly as to the phenomena of accommodation. Prior intraocular lenses have not provided for accommodation, and it is to this aspect of intraocular implant lenses that the present invention is directed.

DISCLOSURE OF THE INVENTION

In accordance with the present invention, an intraocular lens structure is provided which permits accommodation. Thus, in a lens structure having coplanar oppositely directed pairs of feet integrally formed with arched haptics for the support of the lens anterior to the transiridial plane. The present invention involvves a lens having at the haptic portion of the structure a soft material as to be responsive to shape changing forces upon contraction of the ciliary body, increasing the iris-lens spacing and moving the image forward. Further, soft feet may be provided for achieving more gentle interaction between the feet and the scleral spur. In another aspect, the present invention involves an accommodating intraocular lens structure, wherein a rigid lens portion is provided of methylmethacrylate-like material having a posteriorly plano-anteriorly convex configuration. Arched haptics support the lens portion while being integrated in a unitary structure with coplanar oppositely directed feet where at least a portion of the haptics are of soft material, permitting increase in spacing of the lens from the transiridial plane upon contraction of the ciliary muscles.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention may be had by referring to the following detailed description when taken in conjunction with the drawings, wherein:

FIG. **1** is a top view of a lens embodying the present invention;

FIG. **2** is a cross-sectional view taken along line **2—2** of FIG. **1**;

FIG. **3** is a cross-sectional view of the eye showing the lens in situ;

FIG. **4** is a side elevational view of the lens of FIGS. **1-3**;

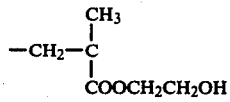
FIG. **5** is an end view of the lens of FIGS. **1-4**; and

FIG. **6** is a top view of a modification of the invention.

DETAILED DESCRIPTION

FIGS. **1-5** illustrate an artificial lens adapted to fixate in the scleral spur of the eye while positioned in the anterior chamber. The structure comprises an optical lens section **9** and supporting structure **6**.

The lens **9** is formed of materials which are biologically inert, i.e., not susceptible to being absorbed by the body fluids and capable of being well tolerated by the human body when implanted. Exemplary of rigid materials is polymethyl methacrylate, hereinafter referred to as PMMA. Representative of soft materials are soft hydrogels of hydrophylic type such as 2-hydroxyethyl methacrylate, generally referred to as PHEMA. By the following formula, one suitable PHEMA compound is specifically identified:



The anterior surface **10** of lens **9** is convex. The posterior surface **11** is planar. The thickness of the lens **9** along the optical axis **14** (FIG. **5**) is variable depending upon the power of the lens.

The artificial lens structure comprising an optical lens portion **9** and supporting structure **6** is preferably manufactured as an integral unit, but with different parts thereof of materials of different compositions. The supporting structure **6** comprises arches **8** terminating in feet **7**. Arches **8** are integral with the lens **9** and with feet **7**.

Arches **8** are in the form of a medial slice out of an inverted disk which has a flat bottom. In such structure, the parallel sides **19** are tangent to the circumference of the lens **9**.

Each foot **7** has two toes **21** forming a chordioid like edge **20** shaped to hold the supporting structure **6** in situ in the anterior chamber of the eye. The sides of foot **7** are parallel to the longitudinal axis of the structure and along the outside of each toe **21** are rectilinear.

In accordance with one embodiment of this invention, lens section **9** is made of material such as PMMA, while the haptics or arches **8** are made of soft material such as PHEMA. With such construction the haptics **8** may be made to undergo beam bending in response to forces produced by muscles in the eye, specifically to move the lens section **9** forward.

Both the haptics **8** and feet **7** may be made of PHEMA material to provide accommodation. In all cases, soft material is employed to permit change in the relationships between the lens section **9** and feet **7** when forces produced present in the eye are encountered. This permits accommodation in a somewhat natural involuntary manner.

The lens in FIG. **6** is much the same configuration as the lens of FIGS. **1-5** except that the sides **19'**, though tangent to lens **9**, are nonparallel, angled inward in the direction of feet **7**.

In FIG. **2** the optical lens **9** shape in its preferred embodiment is shown wherein the anterior surface **10** is