EYE MUSCLE RESPONSIVE ARTIFICIAL LENS UNIT

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of prior U.S. application Ser. No. 08/423,216, filed Apr. 17, 1995, now allowed, which is a continuation of prior U.S. application Ser. No. 08/103,573, filed Aug. 9, 1993, now abandoned, which is a continuation-in-part of prior U.S. application Ser. No. 08/043,009, filed Apr. 5, 1993, now U.S. Pat. No. 5,425,759, which is a continuation of prior U.S. application Ser. No. 07/807,204, filed, Dec. 16, 1991, now U.S. Pat. No. 5,203,790, which is a continuation-in-part of prior U.S. application Ser. No. 07/791,002, filed Nov. 12, 1991, now U.S. Pat. No. 5,203,789, all of which are incorporated herein by reference.

This invention relates generally to method and apparatus for making an eye inserted artificial lens responsive to eye muscle contraction, for proper focusing; and to use of a lens having light ray occluding sections in this environment. There is need for improvements in artificial lenses, to be used for such purposes.

SUMMARY OF THE INVENTION

It is a major object of the invention to provide apparatus and method, meeting the above needs. Basically the invention is embodied in an artificial lens unit insertable into a capsular eye lens zone from which a natural lens has been removed, and comprises:

a) the lens having a light refracting optical portion defining an axis, and consisting of plastic,

b) said unit including haptics for positioning the lens in the capsular zone, the haptics extending at angles relative to a plane normal to the axis and passing through the lens, and the haptics angles characterized in that the lens is displaced in the direction of the axis by the haptics in response to eye muscle constriction of the periphery of the capsular zone toward that axis.

Another object is to provide a lens and haptics unit, and wherein the haptics as viewed edgewise in the direction of said plane have substantially C-shape. Also, the haptics may extend at angles between 15° and 50° between the defined plane.

A further object is to provide such haptics which have integral connection to the lens, and which may hinge relative thereto, other portions of the haptics being sufficiently stiff to transmit lens deflection force to the lens. The haptics may have wire-like strand form, or may be tabular, as will appear; and they may contain eye tissue receiving openings to anchor the haptics against rotation. Their terminals are shaped to fit against inner edge extents of the capsular zone, to receive eye muscle transmitted force. The haptics are variably constrained inwardly toward the optical axis by the edge extents of said capsular zone, to variably and correspondingly displace the lens axially. Also the haptics may have increased thickness along their major lengths, to provide stiffness, and may have reduced thickness close to the lens, to provide for hinging.

The basic method of the invention includes the steps:

a) providing a plastic lens with a light refracting optical portion defining an axis, and

b) providing lens haptics for positioning the lens in an eye capsular zone from which a natural lens has been removed,

c) the haptics provided to extend at angles relative to a plane normal to the axis and passing through the lens, and characterized in that the lens is displaced in the direction of the axis by the haptics in response to eye muscle constriction of the periphery of the capsular zone toward the axis.

Also, the method may include positioning the lens and haptics in the capsular zone so that haptic angularity remains when the haptics peripheries engage interior edge extents of the capsular zone, whereby said haptics are variably constrained inwardly toward the axis by the inner edge extents of said capsular zone, to variably and correspondingly displace the lens axially, as for example to correctly focus light rays from an object onto the retina.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following specification and drawings, in which:

DRAWING DESCRIPTION

FIG. **1** is a frontal view of a lens unit;

FIG. **2** is a section taken on lines **2**—**2** of FIG. **1**, showing haptics angulation;

FIG. **3** is a view like FIG. **2**, and showing haptics increased angulation, in response to cilia muscle contraction;

FIG. **4** shows an angulated lens unit within the eye lens capsule;

FIG. **5** shows a lens unit having tabular haptics;

FIG. **6** is a section taken on lines **6**—**6** of FIG. **5**;

FIG. **7** is a view like FIG. **1**, showing a lens unit having occluded lens sections, and haptics with stiff and hinging sections;

FIG. **8** is a section taken on lines **8**—**8** of FIG. **7**;

FIG. **9** is a side view of a modification;

FIG. **10** is a plan or frontal view of the FIG. **9** modification;

FIG. **11** is a frontal view of a further modification; and

FIG. **12** is a side view of the FIG. **11** modification.

DETAILED DESCRIPTION

FIGS. **1**–**3** show a plastic lens unit **100**; which may be sized for yieldably resilient folding and insertion into an eye zone **98** in a capsule **99** from which a cataractous material lens has been removed. See for example U.S. Pat. No. 4,803,957. The beadlike lens **101** of unit **100** may consist of silicone or equivalent material, and has light passing zone **101*a*** between outwardly convex lens surfaces **101*b*** and **101*c***. Attached to the lens as at locations **102*a*** at circular periphery **102** are two, like, oppositely extending solid haptics **103** and **104**. Loop type haptics may alternatively be employed. See the publication entitled "Simultaneously Endocapsular Implantation of Haptics and Optic Segment Using Cross-Action Folding Forceps" by Henry H. McDonald, M.D. An optical central axis is shown at **105**.

In accordance with the invention, the C-shaped haptics are characterized as variably positioning the lens **101** along axis **105**, in the eye, and within the capsule **99** which bounds the inserted artificial lens and haptics. The haptics extend at angles α relative to a plane **108** normal to axis **105**, in FIG. **2**, forming a shallow C-shape, as viewed. Parallel rays of light **110** are refracted by the lens to focus at point **111*a*** at the wearer's retina **111**.