INTRAOCULAR LENS

FIELD OF THE INVENTION

The invention relates to an intraocular lens with accommodation. The accommodation of the eye for far vision and near vision occurs in the intact natural lens by a change in the curvature of the lens. This results in a corresponding change in the refractive index of the lens. When the natural lens is replaced by an intraocular lens, it is known to provide zones in the intraocular lens which are intended for far vision and zones for close vision. In such intraocular lenses only a fraction of the incident light of the retina becomes available in each instance for far or near vision.

SUMMARY OF THE INVENTION

It is the purpose of the invention to create an intraocular lens of the type mentioned in the introduction, in which the entire amount of light is focused on the retina for far vision and near vision.

This task is solved according to the invention in that the accommodation device has a lens part which can be moved by the force of gravity when the optical axis is inclined with respect to the horizontal level and in that the lens refractive index of the intraocular lens is increased by the lens part which can be moved when the optical axis is put at an incline. In the horizontal position of the optical axis or of the eye, the eye assumes a position for far vision. The position of the parts located in the optical axis is such that the refractive index of the lens is adapted for far vision. When the optical axis is at a downward incline with respect to the horizontal for near vision, for example for reading, the lens part is moved in such a manner that the refractive index of the intraocular lens is increased accordingly.

This can be achieved if the lens part is located outside of the optical axis when the optical axis is in the horizontal position or it can be achieved by moving the lens part along the optical axis. For this purpose the lens part can have an increased refractive index compared to the lens parts which are in the horizontal optical axis, and it can be kept outside of the optical axis when the optical axis is in the horizontal position. The movable lens part can be made of a hard substance, for example a hydrogel, silicone, polymethylmethacrylate or another appropriate lens material. However, it is also possible to make the lens body fluid and to place it inside a second immiscible fluid. The lens body (solid or liquid) can be introduced into a lens chamber. This chamber can be provided on the front side of the lens body or it can surround the lens, forming a shell. Furthermore, the lens body can be shaped so that it has a higher density than the second fluid and it is located in a lower part of the hollow lens or the lens provided with the shell-shaped chamber, so that when the optical axis is horizontal the liquid lens part is outside of the optical axis and it is moved into the optical axis when the optical axis is inclined. It is also possible to use an air bubble which is surrounded by a fluid and which is located either in the optical axis of the eye or outside of the optical axis depending on the inclination of the head.

The lens body can be attached using a standard haptic system in the natural capsule bag of the eye. However it is also possible to implant the intraocular lens using an artificial capsule bag (DE 4,038,088 A1) in the eye. The lens body can be attached rigidly with the artificial capsule bag and it can be shaped in such a way that the lens part with the increased refractive index can only be moved into the optical axis when the latter is inclined with respect to the horizontal line.

However, it is also possible to move the lens part which is responsible for the accommodation along the optical axis of the interior of the capsule bag. The capsule bag can have an additional lens part which has a standard refractive index.

DETAILED DESCRIPTION OF THE DRAWINGS

With reference to the figures the invention is explained further on the basis of embodiment examples. The figures show:

FIG. **1**: a first embodiment example in frontal view with a horizontal optical axis;

FIG. **2**: a lateral view of the embodiment example of FIG. **1**;

FIG. **3**: a frontal view of the embodiment example of FIGS. **1** and **2** with the optical axis at an incline with respect to the optical axis the horizontal level;

FIG. **4**: lateral view of the arrangement shown in FIG. **3**;

FIG. **5**: a second embodiment example with a horizontal optical axis;

FIG. **6**: the embodiment example shown in FIG. **5** with an inclined optical axis;

FIG. **7**: a third embodiment example with a horizontal optical axis;

FIG. **8**: the embodiment example of FIG. **7** with an optical axis with downward incline;

FIG. **9**: a lateral view of a first embodiment example for the third embodiment example with artificial capsule bag;

FIG. **10**: a frontal view of the embodiment form represented in FIG. **9**;

FIG. **11**: a frontal view of an additional embodiment form for the intraocular lens with artificial capsule bag;

FIG. **12**: a third embodiment form for the embodiment example with the artificial capsule bag in a frontal view;

FIG. **13**: a posterior view of the embodiment form of FIG. **12**;

FIG. **14**: a top view of an embodiment example for a movable lens part;

FIG. **15**: a lateral view of the embodiment example represented in FIG. **14**;

FIG. **16**: an additional embodiment example of a movable lens part.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment example represented in FIG. **1** shows a lens body **8** in an intraocular lens. This lens body can also be provided in the usual manner with a haptic system, not represented in detail, by means of which it is attached in the eye in the implanted state. The lens body **8** is fitted with a chamber **3**. A lens part **1** is located in the chamber **3**, which has a higher specific gravity than the medium, for example, a fluid which fills the remaining portion of the chamber **3**. The lens part **1** has a higher refractive index than caused by the lens parts which are located in the horizontal arrangement of the optical axis **2** (arrangement of FIGS. **1** and **2**). In the represented embodiment example with horizontal optical axis, the medium which fills the chamber **3**, for example a transparent fluid, and a lens core **11** are located in the optical axis. In this arrangement the intraocular lens is adapted for far vision.