MULTIFOCAL, ESPECIALLY BIFOCAL, INTRAOCULAR, ARTIFICIAL OPHTHALMIC LENS

The invention relates to a multifocal, especially bifocal, intraocular, artificial opthalmic lens having an optical lens portion of transparent material which covers the pupil of the iris.

An artificial bifocal opthalmic lens based on the alternating or shifting segment principle, in which either only the near range or only the far range of the vision aid is in the ray path and thus is active, is disclosed in U.S. Pat. No. 4,010,496. This lens is provided in the bottom lens portion with a segment-shaped near-focus part. The segment-shaped near focus part and the segment-shaped far focus part situated above it meet at a line of separation. It is a disadvantage of this type of lens that a discontinuity in the image occurs at the line of separation. Furthermore, it has been found that, if at least three quarters of the pupil area is not covered by one or the other zone of sharp focus, double vision and contrast losses develop. It is therefore extremely difficult to determine the correct segment height or the correct shape of the line of separation.

It is the object of the invention, therefore, to create an artificial ophthalmic lens of the kind described above, whereby images of objects at different distances from the observer will be produced simultaneously on the retina, so that the sharp image can be utilized and the blurred image suppressed.

This object is achieved by the invention by disposing near range and far range zones on a transparent optical lens portion of an artificial, intraocular, ophthalmic lens with approximately equal areas symmetrically from the axis of the optical lens portion.

An intraocular lens based on the simultaneous principle is thereby created in which sharp vision is possible simultaneously in the near and far ranges after implantation, because both the lens portions for near vision and the lens portions for far vision are simultaneously in the ray path of the optical lens portion of the ophthalmic lens.

In an advantageous manner, the pupil diameter can be set either during the implantation operation or later by medicinal or microsurgical measures to the optical lens portion to bring the optical lens portion perfectly into the ray path.

The artificial intraocular ophthalmic lens can be designed variously, e.g., as a vitreous-chamber-fixed, anterior-chamber-fixed or iris-fixed lens.

Examples of the embodiment of the intraocular lens according to the simultaneous principle are obtained by the concentric arrangement of the near and far portions, by vertical division of the lens area into a near-effect zone and a far-effect zone, and by dividing the lens area into radially extending areas of near and far effect.

In the embodiment in which the optically active area of the intraocular lens is divided into the near and far range zones in a plurality of concentric annular areas which are disposed alternately in the radial direction, it is also accomplished that visual capacity is not impaired by rapid shifts from bright to dark. This effect can be further enhanced if the ratio of the area of an annular near focus portion to the area of the adjacent annular far focus portion is kept sufficiently constant from the lens center radially toward the lens margin. If the pupil opens rapidly upon a rapid change from light to dark, the area ratio of the near and far range zones remains equal, thus preventing reduction of vision and impairments in seeing.

If the far focus portion is disposed in the center of the optical lens portion, and the near focus portion outside, the optical action of the concentric annular areas which form the near focus part and the far focus part can run progressively radially outwardly. This means that the refractive power increases from the center to the periphery, and this increase in the vertex index of refraction takes place preferably continuously radially from the center to the periphery. If, vice versa, the near focus portion is arranged in the center of the optical lens portion and the far focus portion at the periphery, the optical action of the concentric annular areas which form the near focus portion and the far focus portion can run progressively radially towards the center. This means, then, that the refractive power decreases from the center towards the periphery, this decrease in the refractive power preferably taking place continuously.

It is also possible to divide the near range and far range zones into several sectors of equal angles and to dispose them alternately around the optical axis.

It is furthermore possible to provide the near and far range zones each in one half of the optical lens portion, with the transition or line of separation between the near range zone and the far range zone in the lens implanted in the eye running from the top margin of the lens to the opposite bottom margin of the lens, and the near range zone in the nasal portion of the lens (closer to the wearer's nose) and the far range zone in the temporal lens portion (farther from the wearer's nose). In this case again, brightness differences have no effect, and the lens is independent of pupillary action. Even in the case of pupil dilation occurring due to low lighting and at night, this does not lead to greater blurring of vision, because the percentages (area ratio) by which the far focus portion and the near focus portion are simultaneously covered remain equal.

In the lenses of the invention, images of far objects and near objects are projected simultaneously on the retina. In the central nervous system, the image on which the wearer of the artificial intraocular eye lens is concentrating is selected. An image discontinuity as in the case of the known alternating bifocal ophthalmic lens does not occur. The near and far range zones can be formed on the front and/or back of the optical lens portion. The optical effects of the near and far range zones can be achieved by appropriate surface working of the lens body or by combining materials of different index of refraction. For the achievement of a stenopeic effect, i.e., a greater depth of focus, as in the pinhole camera effect, the lens material can be masked off or darkened peripherally such that a pinhole remains in the center, with a diameter, for example, of the order of 0.5 to 2 mm. An object is projected by this pinhole by means of a narrow bundle of rays. This makes the scatter circles on the retina of the anetrobe eye smaller and thus improves image sharpness.

Another advantageous development consists in the fact that at least the optical lens portion is formed of a flexible, transparent envelope filled with a transparent fluid, which can be attached to the ciliar muscles. When the ciliary muscle contracts, the lens which is at first under tension and therefore more flattened becomes more spherical and thus is given a greater refractive power. To this degree, a continuous changeover of focus between near vision and far vision can be made