

muscles to provide a degree of continuous accommodation. However, the range of movement of the two optics of such IOLs is typically limited, thus restricting the range of viewing distance over which they provide accommodation. This in turn limits the degree of accommodation that can be provided.

Accordingly, there is a need for enhanced IOLs, and particularly improved accommodative IOLs as well as for methods of correcting vision that utilize them.

SUMMARY OF THE INVENTION

In a first aspect, there is provided an accommodating intraocular lens (AIOL) adapted for implantation in a posterior chamber of an eye, comprising

an optic configured to produce a trapezoidal phase shift that causes a linear change in the phase shift imparted to incoming light as a function of pupil radius;

a plurality of haptics, each haptic extending from a haptic-optic junction to at least one transverse arm contacting a capsular bag of the eye and each haptic having sufficient length and rigidity to stretch a capsular bag of the eye to contact ciliary muscles of the eye;

wherein the haptic-optic junctions vault the optic forward relative to the haptics and compression of the haptics by the ciliary muscles exerts a forward force at the optic of at least 1.5 mN and wherein the trapezoidal phase shift augments a visual effect of the forward force to produce a combined effective power change of at least 0.75 Diopters such that different effective depths of focus are provided for different distances and pupil sizes as a result of changes in light conditions.

In a second aspect, there is provided an accommodating intraocular lens (IOL) system, comprising:

an anterior accommodating IOL comprising a positive power anterior optic configured to produce a trapezoidal phase shift that causes a linear change in the phase shift imparted to incoming light as a function of pupil radius and a plurality of anterior haptics on opposite sides of the optic along a haptic diameter, each anterior haptic extending along the haptic diameter from a haptic-optic junction to at least one transverse arm contacting a capsular bag of the eye and each anterior haptic having sufficient length and rigidity to stretch a capsular bag of the eye to contact ciliary muscles of the eye, wherein the haptic-optic junctions vault the optic forward relative to the anterior haptics and compression of the anterior haptics by the ciliary muscles moves the anterior optic forward; and

a posterior IOL comprising a posterior optic and posterior haptics, the posterior haptics extending in a radial direction generally perpendicular to the haptic diameter, wherein the posterior haptics are compressed when the capsular bag is stretched by the anterior haptics and the compression of the posterior haptics forces the posterior optic forward;

wherein the positive power anterior optic having the trapezoidal phase shift and the posterior optic augment produce a combined effective power change of at least 0.75 Diopters such that different effective depths of focus are provided for different distances and pupil sizes as a result of changes in light conditions.

In a third aspect, there is provided an accommodating intraocular lens (IOL) system, comprising:
an anterior accommodating IOL comprising a positive power anterior optic and a plurality of anterior haptics on opposite sides of the optic along a haptic diameter, each anterior haptic extending along the haptic diameter from a haptic-optic junction to at least one transverse arm contacting a capsular bag of the eye and each anterior haptic having sufficient length and rigidity to stretch a capsular bag of the eye to contact ciliary muscles of the eye, wherein the haptic-optic junctions vault the optic forward relative to the anterior haptics and compression of the anterior haptics by the ciliary muscles moves the anterior optic forward; and
a posterior IOL comprising a posterior optic and posterior haptics, the posterior haptics extending in a radial direction generally perpendicular to the haptic diameter, wherein the posterior haptics are compressed when the capsular bag is stretched by the anterior haptics and the compression of the posterior haptics forces the posterior optic forward, wherein the posterior optic further comprises a plurality of protrusions around an anterior surface of the posterior optic, the protrusions extending to an anterior side of the capsular bag.

In a fourth aspect, there is provided an accommodating intraocular lens (AIOL) comprising:
an optic adapted to produce a trapezoidal phase shift that causes a linear change in the phase shift imparted to incoming light as a function of pupil radius; and

a plurality of haptics, each haptic extending from a haptic-optic junction to at least one transverse arm contacting a capsular bag of the eye and each haptic having sufficient length and rigidity to stretch a capsular bag of the eye to contact ciliary muscles of the eye, wherein the haptic-optic junctions vault the optic forward relative to the haptics and compression of the haptics by the ciliary muscles moves the anterior optic forward, and wherein a combined accommodative power produced by the motion of the anterior optic and the trapezoidal phase shift augments a visual effect of the forward force to produce a combined effective power change of at least 0.5 Diopters such that different effective depths of focus are provided for different distances and pupil sizes as a result of changes in light conditions.

In particular embodiments of the present ~~invention~~disclosure, an accommodating intraocular lens (AIOL) adapted for implantation in a posterior chamber of an eye includes an optic and a plurality of haptics. Each haptic extending from a haptic-optic junction to at least one transverse arm contacting a capsular bag of the eye, and each haptic has sufficient length and rigidity to stretch a capsular bag of the eye to contact ciliary muscles of the eye. The haptic-optic junctions vault the optic forward relative to the haptics, and compression of the haptics by the ciliary muscles exerts a forward force at the optic of at least 1.5 mN.

In various embodiments of the present ~~invention~~disclosure, an accommodating intraocular lens (IOL) system includes an anterior accommodating IOL and a posterior IOL. The anterior IOL has a positive power anterior optic and a plurality of anterior haptics on opposite sides of the optic along a haptic diameter, each having a transverse arm contacting a capsular bag of the eye, and sufficient length and rigidity to stretch a capsular bag of the eye to contact ciliary muscles of the eye. The haptic-optic junctions vault the optic forward relative to the anterior haptics and compression of the anterior haptics by the ciliary muscles moves the anterior optic forward. The posterior IOL has a posterior optic and posterior haptics. The posterior haptics extend in a radial direction generally perpendicular to the haptic diameter. The posterior haptics are compressed when the capsular bag is stretched by the anterior haptics and the compression of the posterior haptics forces the posterior optic forward.

In certain embodiments of the present ~~invention~~disclosure, an accommodating intraocular lens (AIOL) includes an optic adapted to produce a trapezoidal phase shift and a plurality of haptics. Each haptic extends from a haptic-optic junction to at least one transverse arm contacting a capsular bag of the eye, and each haptic has sufficient
5 length and rigidity to stretch a capsular bag of the eye to contact ciliary muscles of the eye. The haptic-optic junctions vault the optic forward relative to the haptics and compression of the haptics by the ciliary muscles moves the anterior optic forward. A combined accommodative power produced by the motion of the anterior optic and the trapezoidal phase shift is at least 0.5 Diopters.