OPHTHALMIC PROGRESSIVE POWER LENS AND METHOD OF MAKING SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to ophthalmic lenses. More particularly the invention relates to ophthalmic lenses having progressively varying focal power.

2. Discussion of the Prior Art

The human eye is a wonderful and sensitive organ. It has a lens which is on the outer surface of the eye to receive light from objects in the field of view of the eye. It also has a retina which is positioned in back of the lens to serve as a viewing screen for objects properly focused by the eye lens. When the normal eye views relatively distant objects, the lens is in the relaxed position, and in this position, has the proper curvature on its surface to focus the object on the retina.

Upon the observance of objects at close range, however, eye muscles surrounding the lens act upon the lens to increase its curvature and decrease the focal length of the lens just sufficient to focus the image of the near object on the retina. This ability of the eye to adjust itself for varying object distances is known as "accommodation." As the age of a human being increases, his power of accommodation decreases. This results from the fact that his eye muscles become stiff and weak. For example, a child can normally change the focal powers of his eye by more than 14 Diopters. In middle age, the power of accommodation is reduced to about 3 Diopters, and in old age, the power of accommodation may disappear entirely.

Multifocal lenses such as bifocal and trifocal lenses have been devised to aid the vision of persons who suffer from reduced powers of accommodation. The bifocal lens, for example, is in effect formed from two separate segments of different dioptic powers. The power of one segment is such that vision through it permits focusing on near objects such as reading matter. The other segment corrects the vision for viewing distant objects.

Trifocal lenses are in effect formed from three separate segments of different dioptic powers. These lenses are similar to the bifocal lens, but also include an intermediate viewing segment.

A serious drawback of prior art multifocal lenses resides in the fact that there are optically sharp differences between the viewing portions. This gives rise to confusion when the line of sight scans the optical demarcation lines dividing the segments. This confusion is not only annoying to the user, but also can be quite dangerous causing on occasion serious injury due to falls down stairs and the like.

Several attempts have been made in the past to eliminate lines of optical demarcation in bifocal or trifocal lenses. One solution to this problem is to provide an intermediate region between the near and far vision segments having properties that vary gradually with distance over the surface so as to provide a gradual transition between the near and distance portions of the lens. Such lenses are frequently referred to as "progressive" lenses.

A progressive lens of typical prior art design comprises two refractive surfaces on opposite sides of a block of refringent material. The first (inner) of the two refractive surfaces is usually a spherical or toric surface and the second (outer-convex) is the so-called progressive surface.

This progressive surface is typically designed and manufactured to present an upper single focus spherical surface portion providing a far vision zone or lens portion. This portion has a first focal power and the optical center thereof is the optical center of the whole progressive lens.

Also presented is a lower single focus spherical surface portion which provides the near or reading vision zone or lens portion. This portion has a second higher focal power and is located around a point called the near vision center.

Finally there is presented an intermediate progressive surface portion of which the meridian curve extending from the optical center of the lens to the near vision center is called the meridian of progressian. The spherical power of the lens varies along this meridian of progression from its value at the optical center of the lens to its value at the top of the near vision center according to a predetermined law.

The following U.S. Pat. Nos. are illustrative of prior art so called progressive lenses and represent the most pertinent prior art known to applicant: 2,869,422 Cretin-Maitenaz, 2,878,721 Kanolt, 3,785,724 Cretin-Maitenaz, 4,055,379 Winthrop, 4,056,311 Winthrop.

Additionally, articles by A. G. Bennette in the October and November, 1970 and the February and March, 1971 issues of "The Optician" discuss various attempts to provide progressive lenses.

All prior art progressive lenses exhibit at least one common drawback. As an incident of the aspherical surface of the character found in the prior art progressive lens, a certain amount of astigmatism and distortion typically existed. This distortion tended to be particularly pronounced at the peripheral portions of the transistion or intermediate viewing zone of the lens. The undesirable result of this distortion was a swimming sensation experienced by the wearer when the head was moved in normal fashion. This effect, along with a blurring of vision through the peripheral areas of the lens, has largely been responsible for previous lack of wide acceptance of the progressive lens.

As will become apparent from the discussion which follows, the drawbacks of prior art progressive lenses have been effectively overcome in the unique lens of the present invention, and, in a highly novel manner, the areas of the lens normally exhibiting pronounced distortion have been relocated to those portions of the lens which are minimally used by the wearer of the lens.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a new and unique progressive power ophthalmic lens in which astigmatism and distortion in the peripheral areas of the lens commonly used in normal viewing is significantly decreased.

It is another object of the invention to provide a progressive power lens of the aforementioned character in which the viewing portions of the zone intermediate of the far distance and near distance viewing zones most frequently used by the wearer are uniquely configured and stratigically located to markedly reduce blur or distortion when the wearer is looking at objects in the intermediate range.

It is another object of the invention to provide a new multifocal lens in which the lines of demarcation be-