# BIFOCAL CONTACT LENSES

## BACKGROUND OF THE INVENTION

This invention relates to contact lenses and in particular to bifocal and trifocal contact lenses.

Conventional bifocal contact lenses can be divided into two main types, i.e.

1. Concentric bifocals in which the distance vision zone is in the centre and the reading or near vision zone is a peripheral ring or toroid around the central area. Occasionally the zones are reversed.
2. Bifocals which resemble scaled-down spectacle bifocal lenses. These lens comprise two D-shaped segments, the lower segment being the near vision zone.

In the case of the first type, the size of the central zone is critical, particularly if the lens is fitted tightly to the cornea so that little movement occurs on blinking. The amount of light entering the eye from the distant and near vision zones must be approximately equal, otherwise vision will be biased towards either distance or reading. As the pupil diameter is not static but varies according to the brightness of the light, a compromise must be made in selecting the size of the central zone. This problem is made worse by the fact that the difference in pupil size between the maximum and minimum varies from person to person.

Bifocal lenses of the second type generally have to be fitted slightly looser so that the lens can move over the cornea so that when the wearer is looking straight ahead the line dividing the two segments is below the centre of the pupil, while for reading the opposite situation applies. Thus the location of the dividing line between the distance and reading zones is critical for satisfactory fitting of this type of lens. Although variations in pupil size are less important in the case of this type they can affect the result.

For these reasons a large measure of trial and error inevitably occurs in fitting bifocal lenses of both types, and the practitioner therefore requires a very large inventory to cover all the necessary permutations.

## SUMMARY OF THE INVENTION

A major object of this invention therefore is to provide bifocal lenses wherein pupil diameter and pupil fluctuations have little or no influence on the fitting of the lenses. In order to avoid unnecessary repetition the term "bifocal" is used in the following description and claims to include trifocal lenses, where the context admits.

According to the present invention, there is provided a bifocal contact lens wherein at least the major viewing area is divided into a multiplicity of near and distant vision viewing zones, each near vision zone being adjacent to a distant vision zone or middle distance zone whereby in normal use substantially equal amounts of light enter the eye through the near vision and distant vision zones. By the term "multiplicity of near and distant vision viewing zones" we mean that the lens has more than 3 viewing zones in all. In most lenses in accordance with the invention there will be at least 2 of each type of viewing zone and usually there will be more zones, e.g. 6 or 8 or more.

Generally the distant vision zones will substantially equal in total surface area the near vision zones of the lens, i.e. the ratio of the areas of the near and distant vision zones will be in the range of from about 60:40 to 40:60.

It is unnecessary for the whole surface of the lens to be divided into zones of different powers since it is only the portion of the lens which covers the pupil at its maximum opening which is normally used in vision correction.

There are many possible ways in which the surface of the lens can be divided geometrically into near and distant vision zones. The particular arrangement selected will depend in part on the method of manufacture adopted. For example, where the lens is manufactured on a lens lathe, the front surface may be formed with a series of concentric areas, each annular area being cut alternately for distant and near vision. Alternatively, the back surface can be machined to form the zones of different power.

Another technique for producing zones of different power in the lens is to incorporate segments of material having a different refractive index from that of the body of the lens. Using this approach the lens can be machined or moulded with a single power curvature, the different focal lengths of the near and distant vision zones being achieved by the difference in their refractive indices or their combination of refractive indices.

## BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of bifocal lenses in accordance with the invention will now be described by way of illustration only, with reference to the accompanying drawings in which:

FIG. **1** is a front plan view of one kind of bifocal lens,

FIG. **1A** is a partial transverse section through the lens shown in FIG. **1**,

FIG. **1B** is a view similar to FIG. **1A** of a similar lens in which the front surface has been cut in a slightly different manner,

FIG. **2** is a plan view of the front of another lens in accordance with the invention,

FIG. **3** is a plan view of the front of a third lens in accordance with the invention,

FIG. **4** is a plan view of the front surface of a fourth lens in accordance with the invention,

FIGS. **5A**, **5B**, and **5C** are partial transverse sections through lenses of the kind shown in FIG. **4**,

FIG. **6A** is a vertical section through a mould for forming lenses in accordance with the invention,

FIG. **6B** is a section through the lower half of the mould shown in FIG. **6A** and showing the casting produced,

FIG. **6D** is a view of the top of the casting viewed in the direction of the arrow D in FIG. **6B** and

FIG. **6C** is a diagrammatic view showing the step of machining the resulting casting.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. **1**, a lens is shown having near and distant viewing zones formed as a series of concentric rings.

The shaded rings **1** denote the near vision viewing zones while the unshaded rings **2** denote the distant viewing zones. Of course, in reality, the rings **1** and **2** are equally transparent. These roles can however be reversed. As illustrated the central area **3** of the lens has a focal length which is appropriate for distant viewing while the adjacent zone **1** has a focal length appropriate for near vision viewing. A lens of this kind can be manufactured on a lens lathe by machining the entire power