



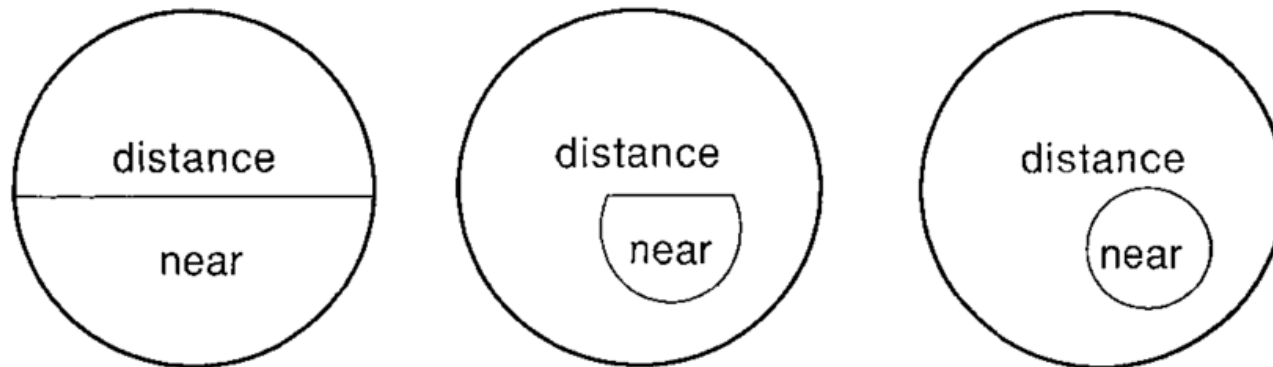
Types of bifocals

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Introduction

- When a patient requires a separate correction for distance and near, he/she may wear lenses which have these correction combined in two distinct areas on each lenses, each area having its own focal properties.
- Or Bifocals, as the name suggests consists of two different lenses, having two different focal points

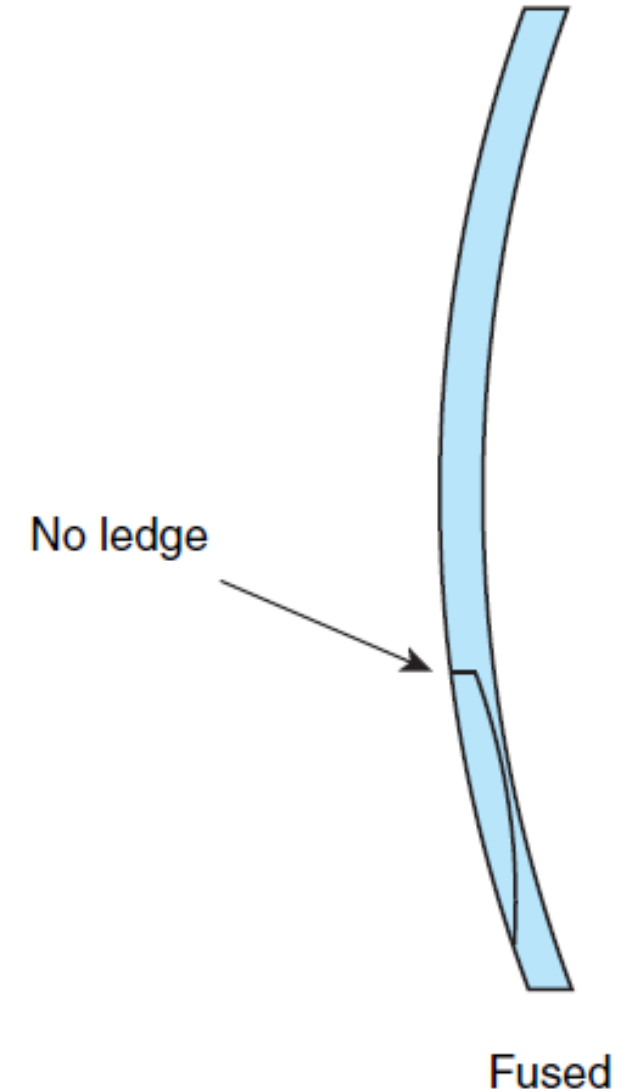


How Bifocals Are Constructed

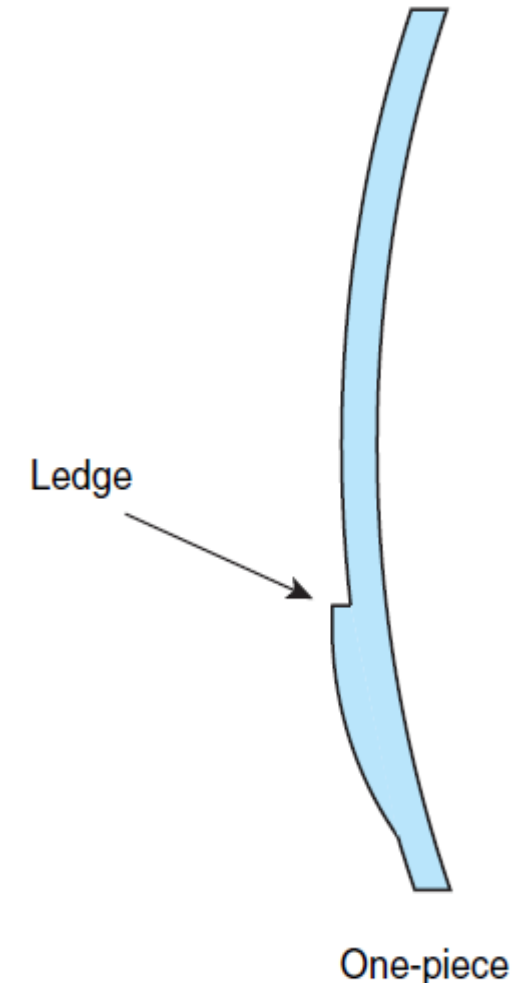
Bifocals and trifocals are usually constructed in three main ways:

1. Fused,
2. One piece,
3. And cemented

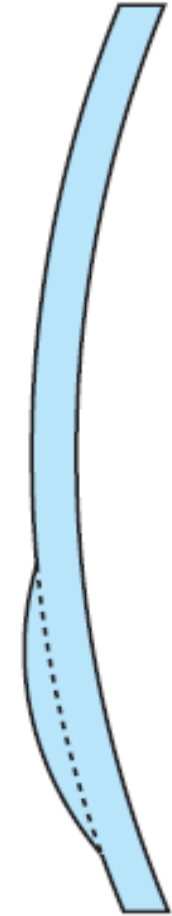
Fused—Fused multifocals are available only in glass. The segment of the lens is made from glass having a higher refractive index than that of the distance “carrier” lens. A fused glass bifocal has no ledge or change of curvature on the front. The segment cannot be felt because it is fused into the distance portion.



One piece—One-piece multifocals are made from one lens material. Any change in power in the segment portion of the lens is due to a change in the surface curvature of the lens. One-piece multifocals can be identified by feeling the segment border. If either a ledge or a change in curvature is felt, the lens is not fused and is most likely a one-piece design. One-piece multifocals may be made from any lens material.



Cement lenses—Cement lenses are custom-made lenses that have a small segment glued onto the distance lens. Used only for specialized custom purposes, such lenses are usually in the form of small, round segments.



Cement

*The distance lens is denoted the “carrier” lens because it is the portion to which the multifocal segment is attached. The segment is carried by the distance portion.

From the time of their origin, the following types of bifocals are available:

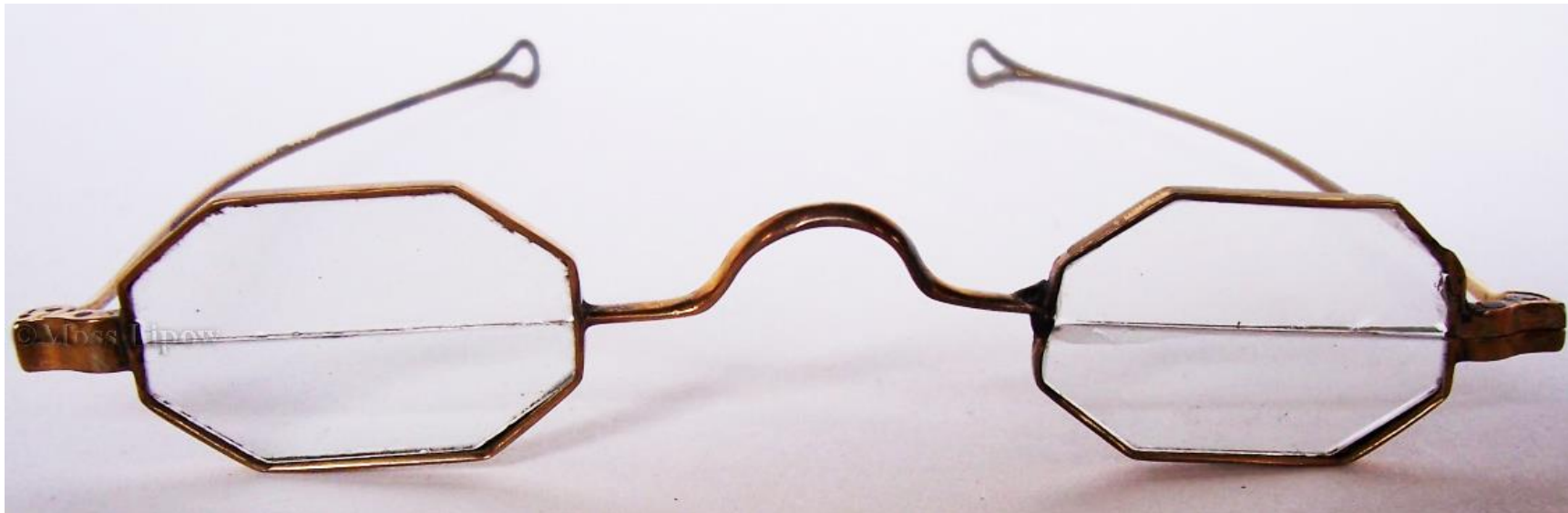
1. Benjamin Franklin's bifocal
2. Solid upcurve bifocal
3. Perfection bifocal
4. Cemented bifocal
5. Cemented Kryptok bifocal
6. Fused Kryptok bifocal
7. Straight top bifocal
8. Ultex bifocal
9. Executive bifocal

Benjamin Franklin's bifocal

- Benjamin Franklin is credited for the invention of the first bifocal lenses on May 23 1785
- Before his invention, Benjamin Franklin used two separate glasses for distance and near vision.
- He got tired of constantly taking them off and putting them on again, so he decided to figure out a way to make his glasses let him see both near and far.



- He had two pairs of spectacles cut in half and put half of each lens in a single frame.
- He joined them together so that the distance correction was on top and the near correction was on bottom of the frame.
- Today, we call them bifocals.



Advantages:

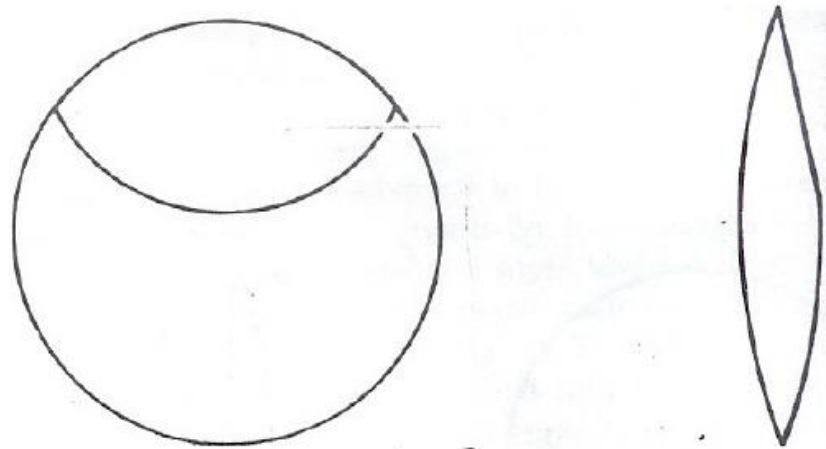
- Large field of view.
- Optical centres of both the distance and near portion is at the dividing line.
- Also, as the optical centres are at the dividing line there is no vertical prismatic jump.
- Less chromatic aberrations.

Disadvantages:

- The lenses are held together by eye wire and come apart easily.
- Dividing line produces annoying reflections.
- Dust accumulation at dividing line.
- As the add power increases, the segment ledge gets bigger and more unsightly.
- Also, this makes the lens heavier.
- Difficult to align the two pieces in case of cylindrical prescription.
- More time and labour required.
- Can be fitted in only frames with eye wire.

Solid upcurve bifocal

- It was the first patented bifocal made from a single piece of glass.
- It was invented by Isaac Schnaitnam in 1837.
- It was manufactured by grounding the near prescription in a lens, and the more distance correction was then ground into the upper back surface.



Advantages:

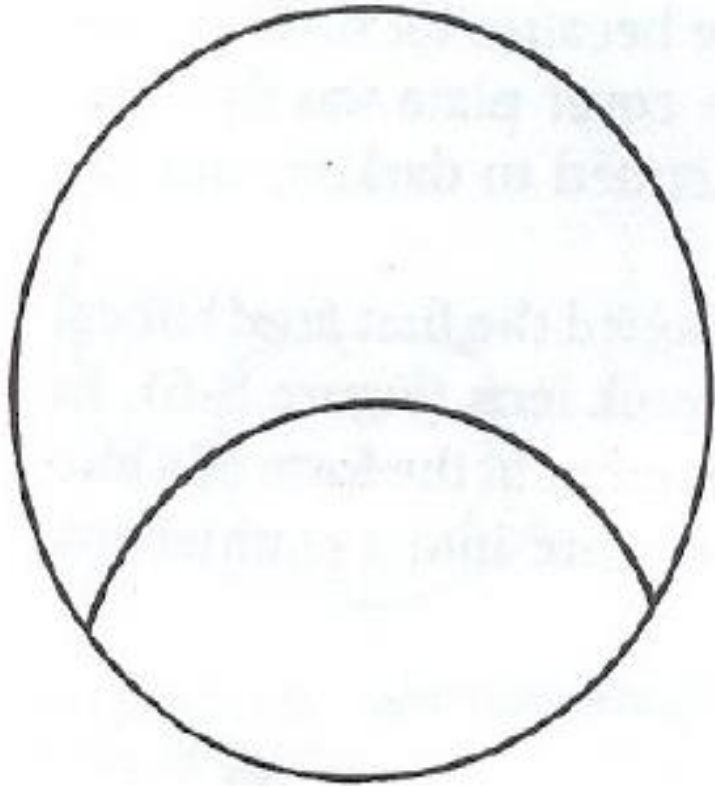
- Better cosmetic appearance better than Benjamin Franklin's bifocal.
- Wide field of view for reading.
- Lesser chromatic aberrations.
- Is structurally stronger.
- Easier to manufacture than Benjamin Franklin's bifocal.

Disadvantages:

- Limited choice of surface powers, significant amounts of aberrations are present in distance portion, which restricted the field of vision.
- Optical centre cannot be easily adjusted.
- Resurfacing of upper portion of back surface moves the optical centre of the distance portion below it's original position.
- Distance portion produces a strong base down prismatic effect and image jump.
- No base curve is available for surfacing. This may also cause a problem in case of anisometropia.

PERFECTION BIFOCALS

- It was invented in the year 1888 by August Marick.
- It was similar to the Franklin bifocal, but was cut in such a way that the junction between the top and bottom portion was a common arc.
- The two portions were joined by bevelling the contact edges, such that they fitted together at the junction.
- The distance portion was larger than the near portion.



Advantages

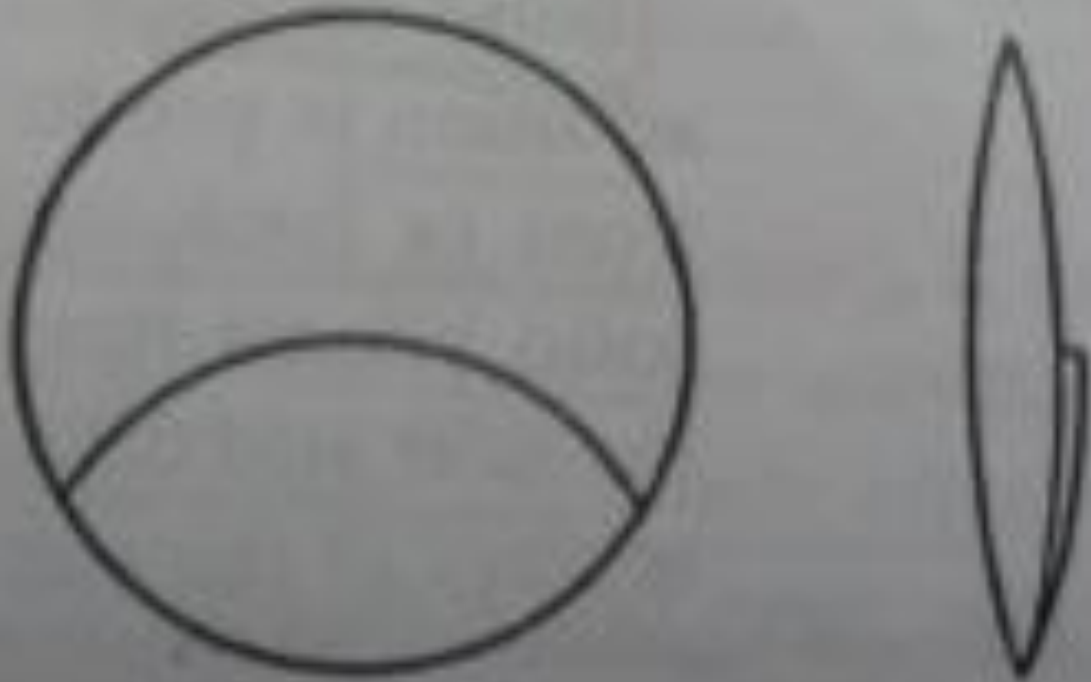
- The lens was stronger.
- It did not come out easily, as in case of Franklin bifocal.
- It had many of the advantages of Franklin bifocal.

Disadvantages:

- Difficult and expensive manufacturing process.
- Dividing line tends to collect dirt.
- Reflections due to dividing line.

CEMENTED BIFOCAL

- It was also invented by Morick.
- A thin wafer of glass with same RI as the major lens was cemented to the back surface of the major lens.
- Canada balsam was used as an adhesive agent.
- Front surface of wafer has same curvature as back surface of major lens.
- Back surface of wafer was made less concave than back surface of major lens.
- The add power was the difference between the curvature of back surface of major lens and back surface of wafer.



Cemented wafer bifocal lens.



The modern variant of the cemented bifocal is the Fresnel lens which sticks in place with water or alcohol. It is used sometimes as a temporary bifocal, but it is too unsightly, expensive, and optically poor for permanent use.

Advantages

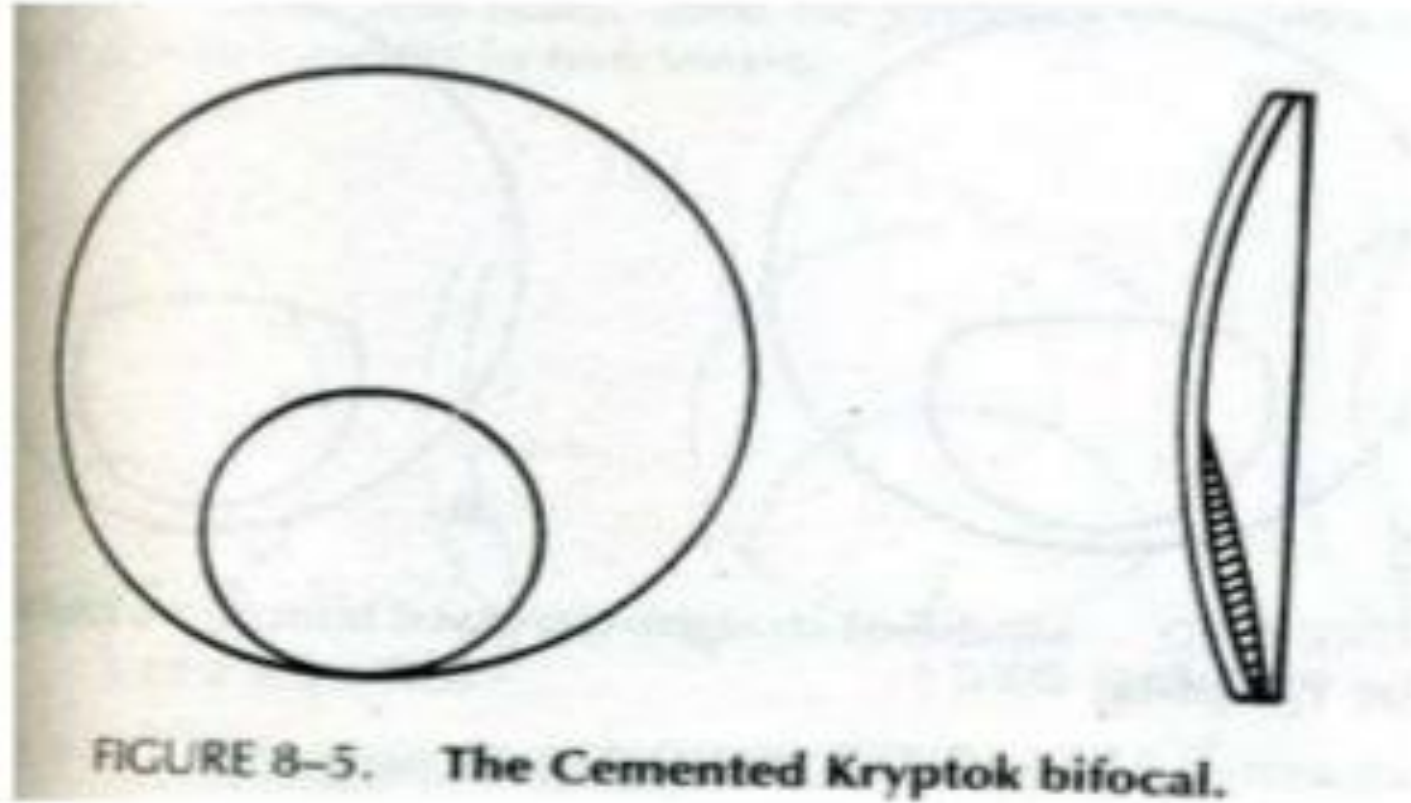
- Cosmetically more appealing.
- Had less optical aberrations.
- Cemented segments are useful because it can be made of any power ranges and positioned anywhere into the main lens. These types of lenses are particularly helpful for a patient with low visual acuity who needs the high add powers (+20.0 DS). A high powered lenticular lens can be constructed using the thermally cemented segment process.

Disadvantages

- Dividing line tends to collect dirt.
- Adherence of wafer is affected by changes in temperature.
- Wafer had a tendency to fall off.

CEMENTED KRYPTOK BIFOCAL

- it was invented by John .L. Borsch in 1899.
- It was the first bifocal lens to make use of two different materials.
- It was manufactured by grinding a countersink curve into the front surface of the major lens of ophthalmic crown glass.
- Then a wafer of flint glass was cemented into the countersink area, and the surface was covered with a thin meniscus of glass cemented into place.



- The add power was generated because of RI of the segment and the concave interface between the segment and major portion.

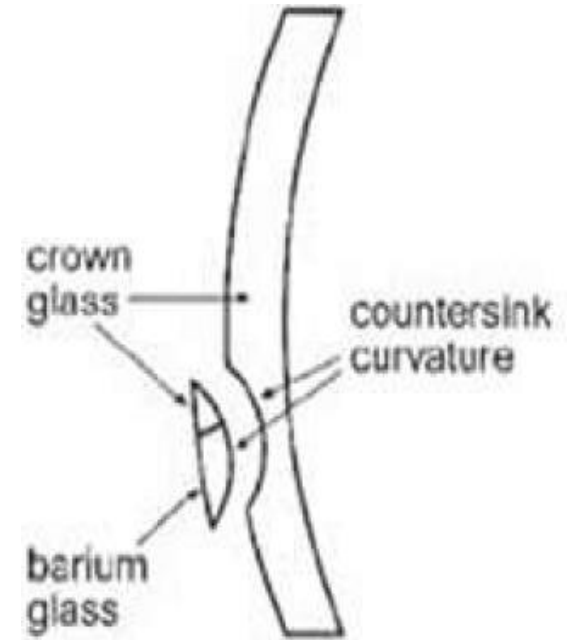
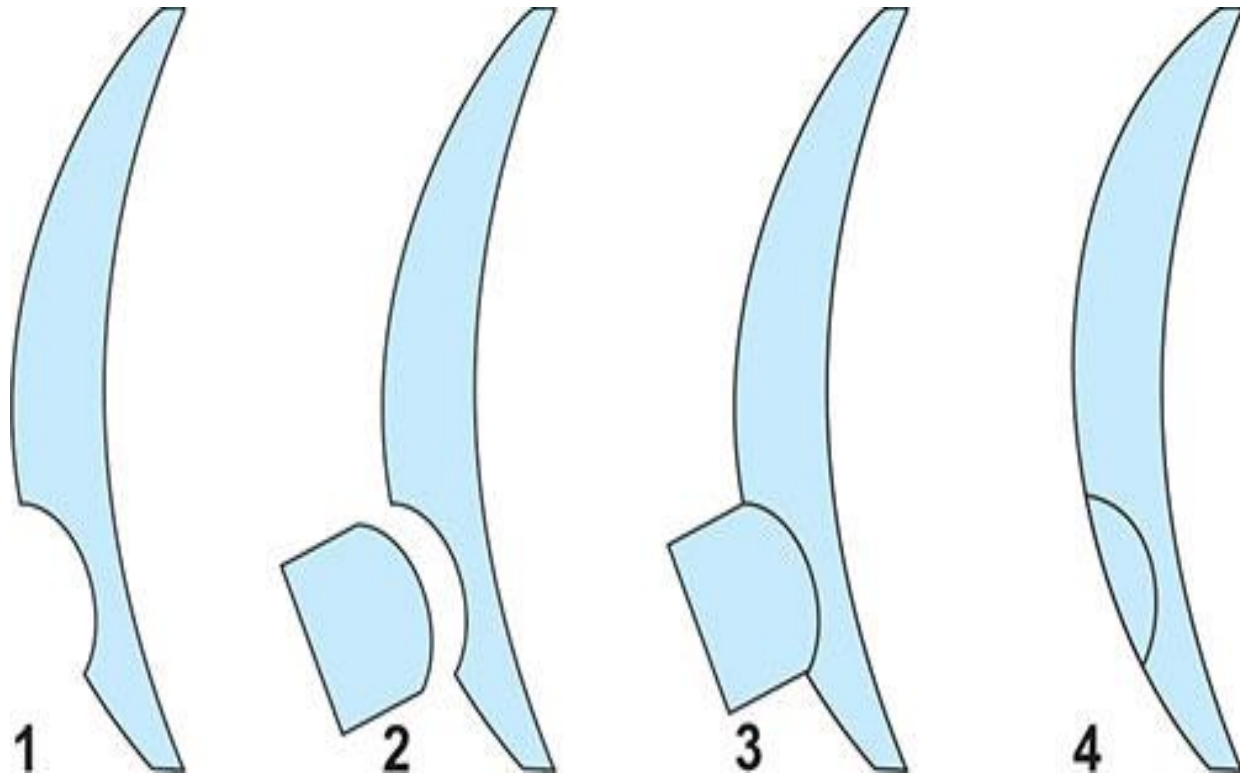
Disadvantages

- Difficult to manufacture because six surfaces had to be ground and polished.
- Cemented surfaces tend to darken.
- Thin and fragile cover plate.
- Wafer used to come apart after some time.

FUSED KRYPTOK BIFOCAL

- It was developed by John Borsch Jr. in the year 1908.
- During the manufacturing process a round countersink cavity was ground and polished on the front surface of the major lens.
- The back surface of the of the round flint button was ground and polished to a curvature of radius only slightly less than the countersink curve.

- The flint button was placed in the countersink and heated to 600-700 degree centigrade, at which it softened and fused to the countersink.
- The front surfaces of the fused lenses were ground and polished until there was a uniform anterior surface curve and the edge of the flint button was eliminated,
- Any cylindrical component had to be ground on the back surface of the lens.



Advantages

- Segment edges do not collect dirt and dust.
- Segment do not fall out, become discoloured or chip.
- Lenses can be produced in large quantities at low cost.
- Its relatively light

Disadvantages

- Flint segment produced high chromatic dispersion. Hence, colour fringes and chromatic aberrations were produced.
- To prevent strain during manufacturing process along the fused surface, the coefficients of expansion of the two glasses must be matched from fusing temperature to room temperature.
- High speed polishing of the surfaces to be fused produces tension on the surfaces. During heating, the tension may be released, producing an irregular surface.

D BIFOCALS

- Also known as Flat-top bifocal.
- Henry Courmettes patented the idea of fusing into a major lens button that was made of two kinds of glass in the year 1915.
- The button had upper half of the button of same RI as that of the major lens, but the lower half of the button was of higher RI.
- So, the upper half of the button was invisible and only the boundary between the two different materials of the button remained visible.



- They were first introduced by the Univis company in 1926.
- The first straight top bifocal to be patented was the B segment bifocal.
- Various modified forms of the flat top bifocal were introduced later.

Advantages

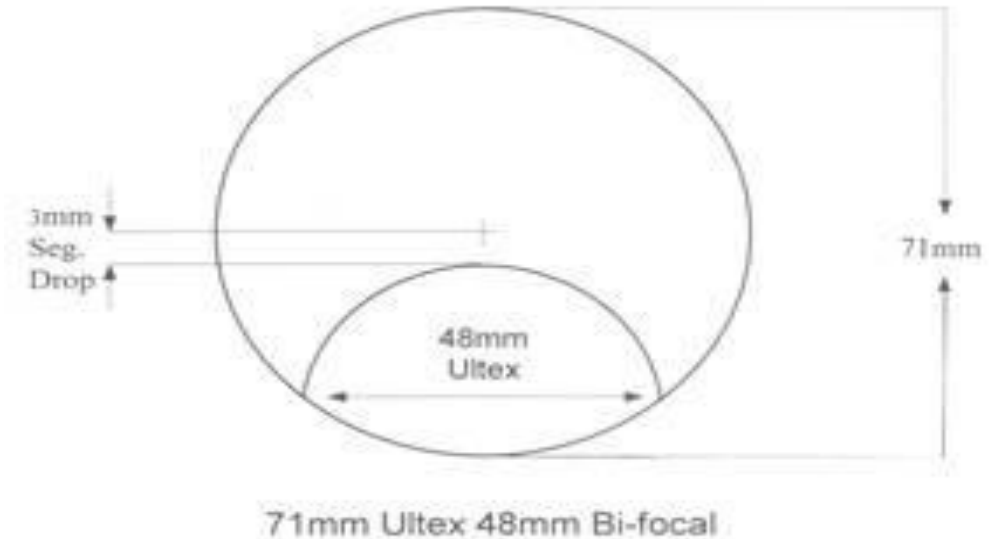
- Cosmetically more appealing.
- Less optical aberrations.
- Lesser image jump and prismatic effects.
- It is lighter.
- No inset is required.

Disadvantages

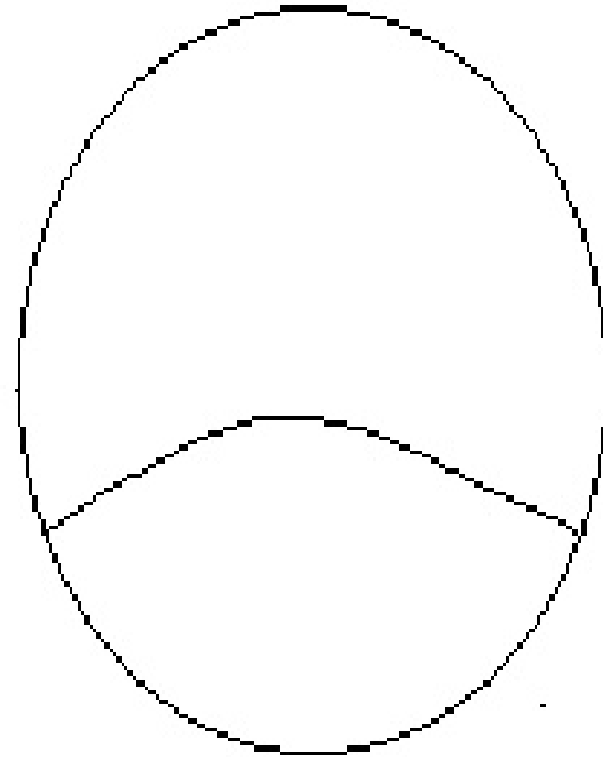
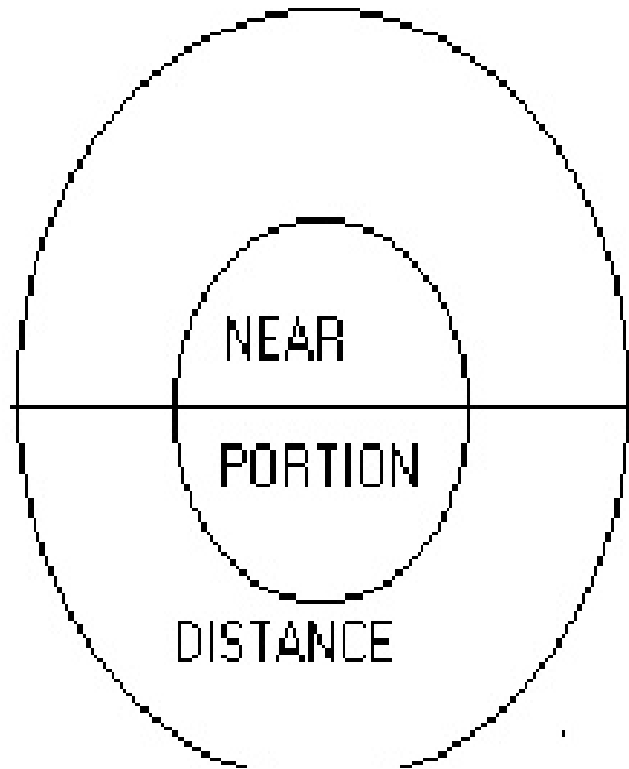
- Though nearly invisible, its presence is obvious on inspection
- The reading area is somewhat reduced
- The dividing line can cause certain problems. Eg. While climbing stairs.

ULTEX BIFOCAL

- It was produced by O'Connerin 1910.
- It is a one piece bifocal made out of ophthalmic crown glass.
- The add for the reading segment is obtained by change in curvature, on the back surface of the lens.



- Ultex A is ground with a central disk diameter of 38mm. After grinding the blank is cut into two lenses, each having a segment height of 19mm.
- If a segment height of more than 19mm is required, then only one lens is cut from the blank.



Advantages

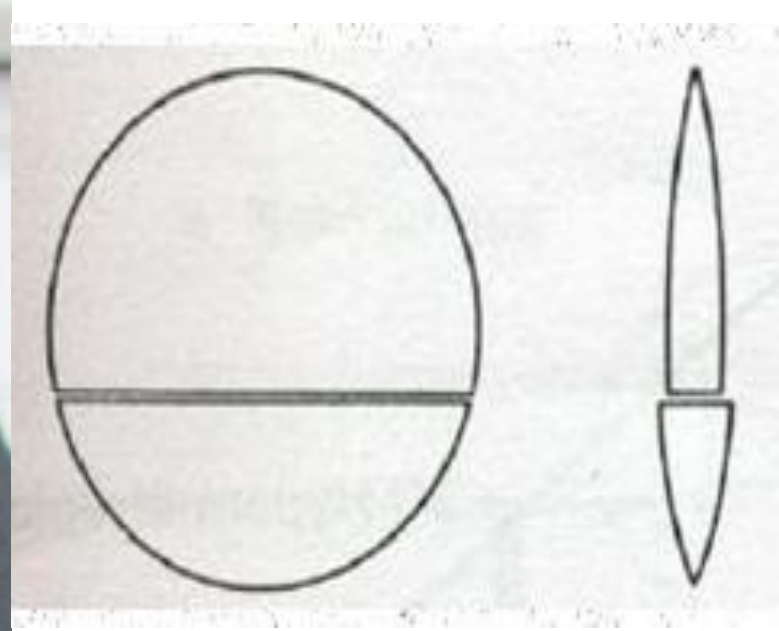
- Has lesser chromatic aberrations.
- Has a larger field of view for reading portion.
- Spectacles may be ground in plus cylinder form for patients who cant adapt to minus cylinders.
- They can be used, in principal, in a dissimilar segment pair to compensate vertical imbalance

Disadvantages

- Produces more image jump and prismatic effect.
- it isn't available anymore!!!

EXCECUTIVE BIFOCALS

- They were developed in the year 1954, by the American optical company.
- The near add is ground on the front surface of the lens.
- The front surface has a more convex curvature in the lower portion than in the upper portion, which creates a ledge.



Advantages:

- It has a large field of view. Eg for accountants.
- Has lesser chromatic aberrations.
- Minimal prismatic effect.

Disadvantages

- Its heavy.
- Its ugly.
- Dust accumulates in the long, deep crevice.
- The edge of the segment chips easily.

