as shown graphically in FIGS. 3, 5, 6 and 7, for one base curve and diameter of the series of lenses of this invention can be computed by means of Equations 1 through 5 for all base curves and diameters in the complete series with diameters ranging from about 7.50 mm. to 10.50 mm., which is the range of lens diameters generally used in clinical practice with corneal contact lenses. It is to be understood that small variations in lens diameter necessitate small changes in eccentricity of the convex surface of the contact lens of a specific base curve, if minimal thickness lenses are to be obtained. It is also to be understood that although 0.15 mm. is a satisfactory minimal center and/or edge thickness for contact lenses, greater and lesser thicknesses may be used without departing from the intent of this invention.

When a contact lens of the lens series of this invention is ordered to meet the specifications of a prescription, the order to the manufacturer will include the following data:

(1) Apical radius of curvature of the cornea;

(2) Eccentricity or approximate eccentricity of the cornea;

(3) Diameter of the contact lens;

(4) Power of the prescribed contact lens.

By referring to graphs similar to FIGS. 5, 6 and 7, for the prescribed base curve and diameter, the front surface apical radius of curvature and eccentricity, and the center thickness of the lens, can be obtained by selecting the r, and t values corresponding to the prescribed lens power, and the e value corresponding to the r value.

The production of the exact conoid surfaces for the lens series of this invention is accomplished by apparatus and methods disclosed in my copending patent applications as follows.

Exact positive and negative prolate ellipsoids, paraboloids, and hyperboloids of two sheets can be generated by the direct machining method described in my United States Patent for "Method and Apparatus for Producing Aspheric Contact Lenses," No. 3,344,692, granted Oct. 3, 1967, in which the said surfaces are generated by machine tools having edges in the form of ellipses, said elliptical edges being oriented and positioned with respect to the surface generated, in a predetermined manner, so as to produce the desired surface.

Exact positive prolate and oblate ellipsoids can be produced by a direct machining method described in my United States Patent No. 3,218,765, granted Nov. 23, 1965, for "Lens Generating Method," my United States Patent No. 3,267,617, granted Aug. 23, 1966 for "Lens Generating Apparatus," which describe the production of prolate and oblate ellipsoids by tools having circular generating edges, the planes of said circular generating edges being oriented and positioned in a predetermined manner with respect to the surface to be, generated, said circular edges being made to move across the surfaces, as the lens material rotates about its axis of revolution.

Exact positive and negative prolate and oblate ellipsoids can be generated by the method and apparatus described in my United States Patent No. 3,239,967 granted Mar. 15, 1966 for "Lens Surface Generator," in which a rotating generating tool in the form of a circular disc, is made to follow a predetermined path by means of a cylindrical cam follower, of the same diameter as the circular grinding tool, rolling along a circular edge of predetermined radius of curvature, the plane of said circular edge being oriented and positioned in a predetermined manner with respect to the surface to be generated.

Wherever in the specification and claims I have referred to corneal contact lenses, I mean to include scleral contact lenses also which differ from the corneal type in that a thicker layer of tear solution is interposed between the back surface of the optical portion of the lens and the cornea, this being achieved by a scleral flange of the lens material adjoined to the corneal portion and resting upon the sclera. This invention, however, makes possible a substantially uniform and minimal thickness of the tear solution between the entire surface of the cornea and the optical portion of the lens.

What is claimed is:

1. A series of corneal contact lenses with the corneal surface of each lens being a continuous and regular aspheric surface of revolution of conoid type which decreases in curvature from apex to peripheral edge, said lenses being arranged with reference to their corneal surfaces in a graded series of apical radii of curvature of said surfaces with values ranging from 6.50 mm. to 8.50 mm. in steps of 0.05 mm. and having eccentricities of 0.4 to 1.6 in steps of 0.1 units for each apical radius, and of sufficient thickness for providing optically coacting front surfaces.

2. A series of corneal contact lenses as defined in claim 1 in which the optically coacting front surfaces are oblate ellipsoids with eccentricities from 0.0 to 0.9.

3. A series of corneal contact lenses as defined in claim 1 in which the optically coacting front surfaces are prolate ellipsoids with eccentricities from 0.0 to 1.0.

4. A series of corneal contact lenses as defined in claim 1 in which the optically coacting front surfaces are hyperboloids with eccentricities from 1.0 to 1.80.

5. A series of corneal contact lenses as defined in claim 1 in which for generally negative power lenses of center thickness t, semi-diameter h, and in which the corneal surface has a vertex depth x, the eccentricity of the front surface being not greater than that of the corneal surface, lenses with substantially equal center and edge thickness are made when the front surface being a conoid of decreasing curvature from apex to peripheral edge, has an apical radius of curvature r and an eccentricity e related to the corneal surface by the equation:

$$r=\frac{h^2}{2x}+\frac{(1-e^2)x}{2}+t$$

6. A series of corneal contact lenses as defined in claim 1 in which for generally negative power lenses of center thickness t, semi-diameter h, and in which the corneal surface has a vertex depth x, lenses with substantially equal center and edge thickness are made when the front surface, being an oblate ellipsoid, has an apical radius of curvature r, and an eccentricity e related to the corneal surface by the equation:

$$r=\frac{h^2}{2x}+\frac{x}{2(1-e^2)}+t$$

7. A series of corneal contact lenses as defined in claim 1 in which for generally postive power lenses of semi-diameter h and in which the corneal surface has a vertex depth x and eccentricity e_{base} and an apical radius of curvature r_{base}, lenses with minimal center thickness and of edge thickness t are made when the front surface is a conoid of decreasing curvature from apex to peripheral edge of eccentricity e, of vertex depth v and of apical radius of curvature r, when

$$e=\left(\frac{2h}{v\tan\gamma}-\frac{h^2}{v^2}+1\right)^{1/2}$$

and

$$r=\frac{h^2}{v^2}-\frac{(e^2-1)v}{2}+t$$

where

$$\gamma=\tan^{-1}\frac{h}{r_{\text{base}}+(e^2_{\text{base}}-1)x}$$

(References on following page)