METHOD FOR PRODUCING OPTICAL ELEMENTS WITH ASPHERICAL SURFACES

This invention relates to a method of producing aspherical optical surfaces or diopters and more particularly to a method of producing an optical plate for compensating aberrations in the spherical mirrors of telescopes and eye glasses or other optical instruments.

There are already various methods for producing compensating optical plate in particular according to the method of Bernard Schmidt in which the optical plate is curved by reducing the pneumatic pressure acting on one of the faces of the optical plate.

According to this method a planar optical element is centered on a circular cavity having an outer radius smaller than that of the lens, the connection between the cavity and the optical element being airtight, and a vacuum is then created in the cavity. The force exerted by the atmospheric pressure thus deforms the optical element whereas the vacuum maintains the optical element deformed and the face of the optical element subjected to the vacuum is then polished with convex tools whose curvature is suitably chosen.

This known method has various disadvantages.

One of the most important disadvantages resides in the fact that the Schmidt method requires for a particular useful diameter of the optical element a change of radius of curvature of the surfacing tools for each different optical element.

Another disadvantage of the said method is that it requires a certain amount of final retouching with surfacing tools having a diameter much smaller than the diameter of the surface of revolution being finished. Since the retouching is inevitably localized, a surface waviness is effected which causes a straying or diffusion of light and an alteration of the diffraction spot.

Further, when it is desired to provide optical elements with a Kerber profile by means of the Schmidt method, it is necessary to turn the optical elements over to have them undergo a second annular concentric deformation with respect to the first and then finish this second surface.

It therefore follows from the above that the production of such optical elements necessitates a series of long, delicate and imprecise and therefore costly steps which do not enable the achievement of the desired quality.

The present invention has for an object a method of producing aspherical refractive surfaces of the Schmidt and Schmidt-Kerber types which obviate the aforesaid disadvantages.

The method according to the invention is a considerable simplification of the manufacture of compensating or corrective optical elements for telescopes, eye glasses and other optical instruments while using the same mounting of the optical elements and the same surfacing tools, which are preferably planar, irrespective of the number of optical elements to be worked; and carrying out this deformation by at least two pneumatic pressure-reducing or vacuum means.

The manufacture of the compensating or corrective optical elements is therefore much more rapid and their surfacing more accurate.

The method according to the invention consists in working the entire surface of the lens (planar or spherical) in the customary manner by means of tools, preferably planar or possibly spherical, having the same diameter as that of the optical element whereas the optical element undergoes a static deformation in a pneumatic apparatus, the said method being characterized in that the said apparatus comprises a circular central chamber and at least one annular chamber concentric with the circular chamber adapted to be subjected to a vacuum, the said chambers being hermetically separated in order that they may be subjected to different degrees of vacuum, from each other, the separation between the chambers is assured by annular sealing members having diameters which correspond to the circular zones of support for the optical element which are not subject to any deformation but which have a revolution symmetry at the level of the support, and the optical element after surfacing and polishing one face being turned over in order to surface and polish the other face whereas the optical element is deformed by vacuum, the relationship between the radius, the weight and the thickness can be different for each of the faces of the optical element.

The rigidity of the plate carrying the chamber is chosen as a function of the optical element to be worked.

Different profiles or shapes can be given to an optical element in using polishing tools with appropriate curvatures for each face of the optical element.

The invention will be described in greater detail hereinbelow with reference to the accompanying drawings wherein:

FIG. 1 is a schematic showing of the principle of the method according to the invention; and

FIG. 2 is a schematic showing of the principle according to a variation of this method.

Owing to a choice of pressures and diameters, the surfacing is more convenient and more economical because there is no need to retouch the surface obtained by static deformation as it is of the same quality as a spherical or planar surface which has not been deformed.

The circular optical plate is placed on a circular sealing support member having a smaller diameter than that of the optical plate fixed on the upper wall of a vessel which can be put under a vacuum or at atmospheric conditions. The optical plate bends at its central portion when a vacuum is created in the space between the optical plate and the bottom having an aperture at its center.

According to the invention, the optical plate **1** (FIG. **1**) placed on an airtight circular support **2** resting on a base plate **3**, can be placed under a vacuum at its central portion as well as at its periphery.

Accordingly, the base plate **3** is formed with a recess into the bottom of which extends a channel **4** communicating with a conduit which can be connected to a vacuum. The side wall of the recess includes a circular shoulder **5** which can be eliminated if it is desired to flatten the sealing support member **2** by surfacing and on which is placed an annular seal **6** in which is gripped the optical plate **1**. Beyond the sealing support member **2** a channel **7** extends into the bottom of the recess and can be in communication with a vacuum conduit independent of that connected to the channel **4** in the base plate.