the increased support for the die plate **14** rather than at the prior stage following separation from the master die block **10.** The resultant composite structure comprises the die block assembly generally designated by the numeral **16.**

In the next step of the method, a deformable glass blank **30** of generally disc-shaped configuration is carefully selected to ensure good optical properties. It is ground and polished to optical flatness on at least one of its parallel surfaces **32, 34** and one of the optically flat surfaces **34** is placed in contact with the aspheric surface **28** of the die block assembly **16.** Sealant **19** is placed about the circumferential joint between the glass blank **30** and inverse die plate **14,** and a vacuum is then drawn through the passages **27** and **23** to deform the glass blank **30** into optical contact with the surface **28** of the die block assembly **16,** as seen in FIG. **9.**

In the next step, the exposed surface **32** of the glass blank **30** is ground and polished to optical flatness with the glass blank **30** maintained in deformed optical contact with the inverse die plate **14** of the die block assembly **16.** The resultant condition of the glass blank **30** is illustrated in FIG. **10** prior to release of the vacuum and removal of the glass blank **30** therefrom.

Lastly, the vacuum being drawn through the passages **27** and **23** of the die block assembly **16** is released, the sealant **19** removed and the glass blank **30** separated from the die block assembly **16.** Upon separation the glass blank **30** assumes its undeformed condition with the surface **32** as seen in FIGS. **9** and **10** assuming an aspheric curved configuration **33** identical to the aspheric surface **26** of the master die **10.** The opposite surface **34** which has previously been polished to an optical flat returns to its normal optical flat condition. The finished optical plate **30** is thereafter cleaned and inspected to ensure freedom from flaws and may be tested directly in a same or similar optical test bench.

In order to ensure complete optical contact of the glass plate being formed over the full surface area to be configured, it is frequently desirable to make the master die and die block assembly somewhat larger than the intended diameter for the finished piece, particularly where th curve is relatively steep on the order of *f*/2. This accommodates the tendency for the glass plate to tend to pull up about the circumference during the grinding and polishing operations in the event that the seal about the joint therebetween should fail. For example, in the manufacture of finished Schmidt corrector plates of 8 inches diameter, the dies and the glass blanks employed are conveniently 10 inches in diameter with the circumferential portion being removed at the end of the fabricating operation. However, where the curve is relatively shallow (on the order of *f*/5), it is much easier to draw the plate into full contact over the entire surface.

It is extremely important that the dies and the glass plates being formed into the finished product be coaxially aligned to ensure concentricity within the system and to permit interchangeability. This is most conveniently accomplished by grinding the disc-shaped pieces being employed to fabricate the die components and the glass blanks being processed to close tolerance as to diameter and to circumference. In practice a tolerance of not more than about 0.001 inch should be held to obtain superior results. The disc-shaped elements may then be concentrically aligned using the ground circumferential edges and dial indication to ensure dimensional and configurational accuracy.

This high degree of control of the circumferential dimension and configuration facilitates other operations such as the coring operations necessary to provide the through passages for drawing the vacuum and the cutting operations to provide the grooves. The glass disc may be disposed within a precision cavity of a jig or other suitable holding apparatus and the various points determined from the periphery. Moreover, after precision coring of the center passage of the final product, the peripheral portion may be removed by then locating in the precision core a radial arm cutter which will cut away the peripheral portion as it is rotated about the core.

The number and pattern of the grooves to assist in drawing the vacuum over the entire contact surface area may vary depending upon the size of the components, the amount of vacuum to be drawn and the amount of deformation desired as well as the thickness of the glass elements being deformed. The wheel and spoke pattern illustrated serves efficiently with the circumferential groove being located close to the outer edge of the glass area intended to be used. As seen the grooves communicate with the passage through which the vacuum is being drawn and serve to distribute the applied vacuum over the contact surface. The grooves should be relatively shallow to maintain the strength of the glass and should be relatively narrow to preclude any tendency of the glass being deformed thereinto.

In the described process only a central passage through the master die block and die block assembly is shown, but a plurality of passages may be used and may extend from anywhere on the curved surface of the die block to the opposite or a lateral surface. The surfaces of the master die block are generally ground and polished parallel prior to figuring one surface thereof but any wedge may be ground out during the figuring process.

The surfaces of the vacuum deformed glass blank and glass plate are generally ground and polished optically flat, but a curvature may be figured thereinto if changes are desired in the finished optical surface while retaining the configuration of the master die block. Otherwise, the master die block may be refigured, tested, and optical pieces having completely different aspheric surfaces produced therefrom.

The master die block, base die block, and reverse die plate are most preferably formed of Cervit, quartz or fused silica, but may be of any glass having comparable durability and a low thermal coefficient of expansion. The corrector plates are normally made from plate glass having good optical qualities, but certainly other glass may be used. The sealing substance used is wax or, if a semi-permanent bond is desired, fingernail polish, but clearly comparable substitutes may be used therefor.

Thus, it can be seen from the foregoing specification and drawings that the method of the present invention provides a novel and relatively facile method for producing complex aspheric optical surfaces. A solid, rugged master die with one surface having the curve to be produced is used, thus facilitating direct testing thereof.

Having thus described the invention, I claim:

1. In a method for making complex aspheric optical surfaces, the steps comprising:

a. forming a thick, non-deformable integral glass block with a pair of substantially parallel flat surfaces;