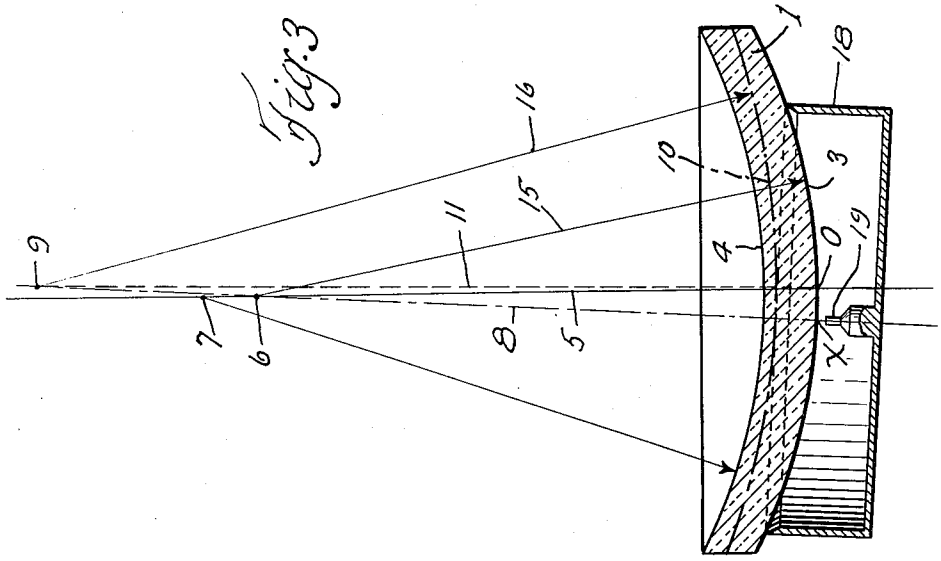
March 20, 1951 G. A. CLEMENT 2,545,448

APPARATUS FOR GRINDING LENSES

Filed June 27, 1947 3 Sheets-Sheet 1

Fig. 3



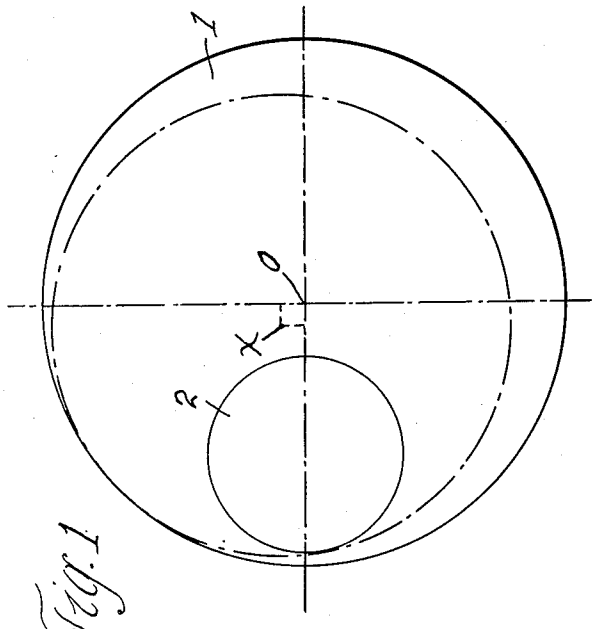


Fig. 1

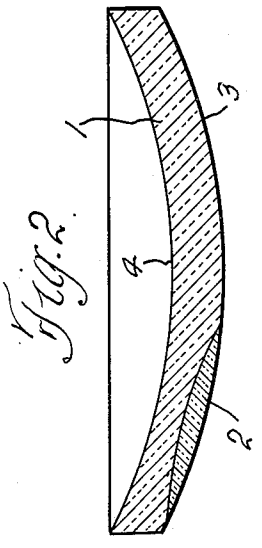


Fig. 2

INVENTOR.
George A. Clement
BY Victor J. Bono
Atty.

March 20, 1951 G. A. CLEMENT 2,545,448

APPARATUS FOR GRINDING LENSES

Filed June 27, 1947 3 Sheets-Sheet 2

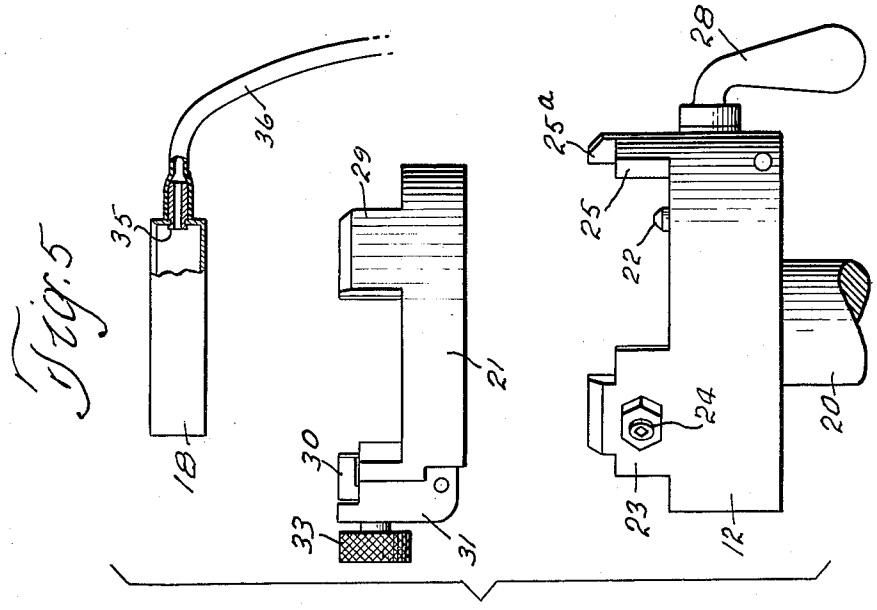


Fig. 5

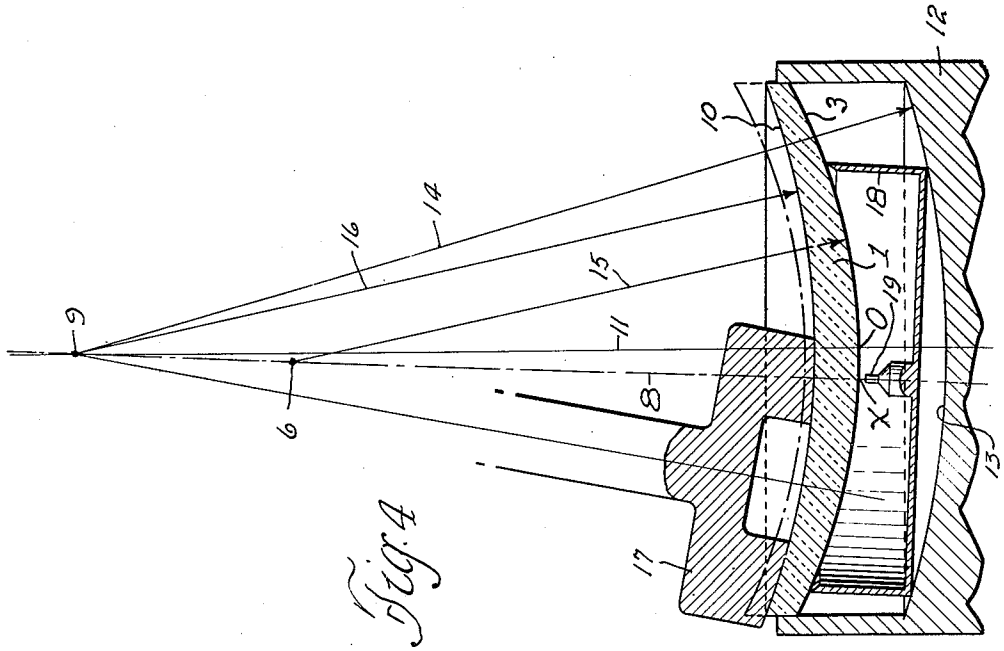


Fig. 4

INVENTOR.
George A. Clement
BY Victor J. Bonat
Atty.

March 20, 1951 G. A. CLEMENT 2,545,448

APPARATUS FOR GRINDING LENSES

Filed June 27, 1947 3 Sheets-Sheet 3

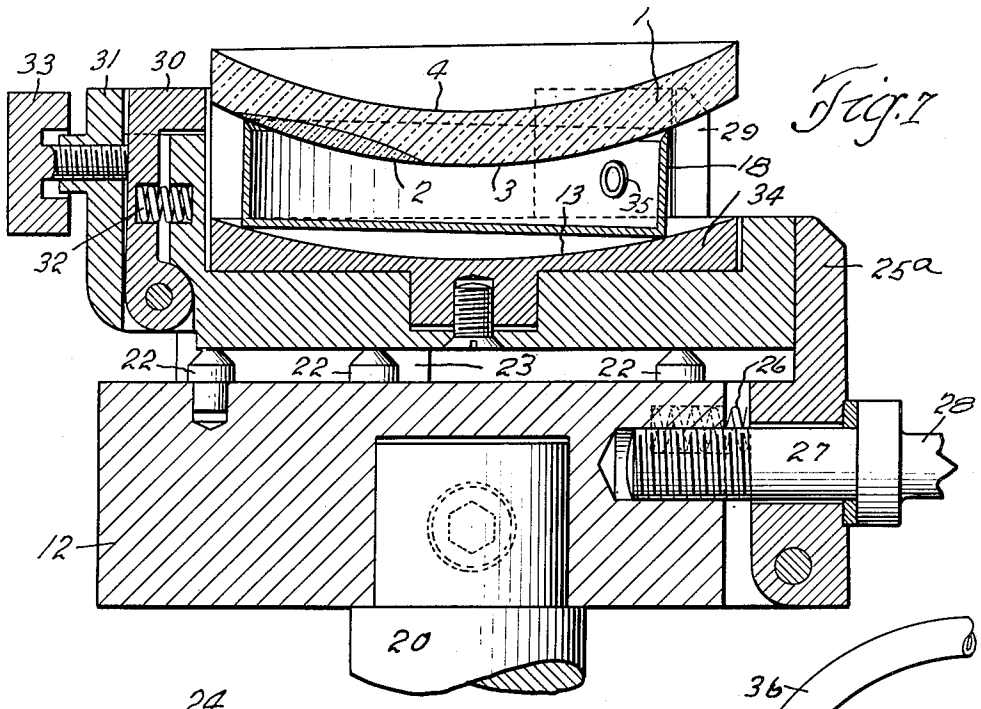


Fig. 1

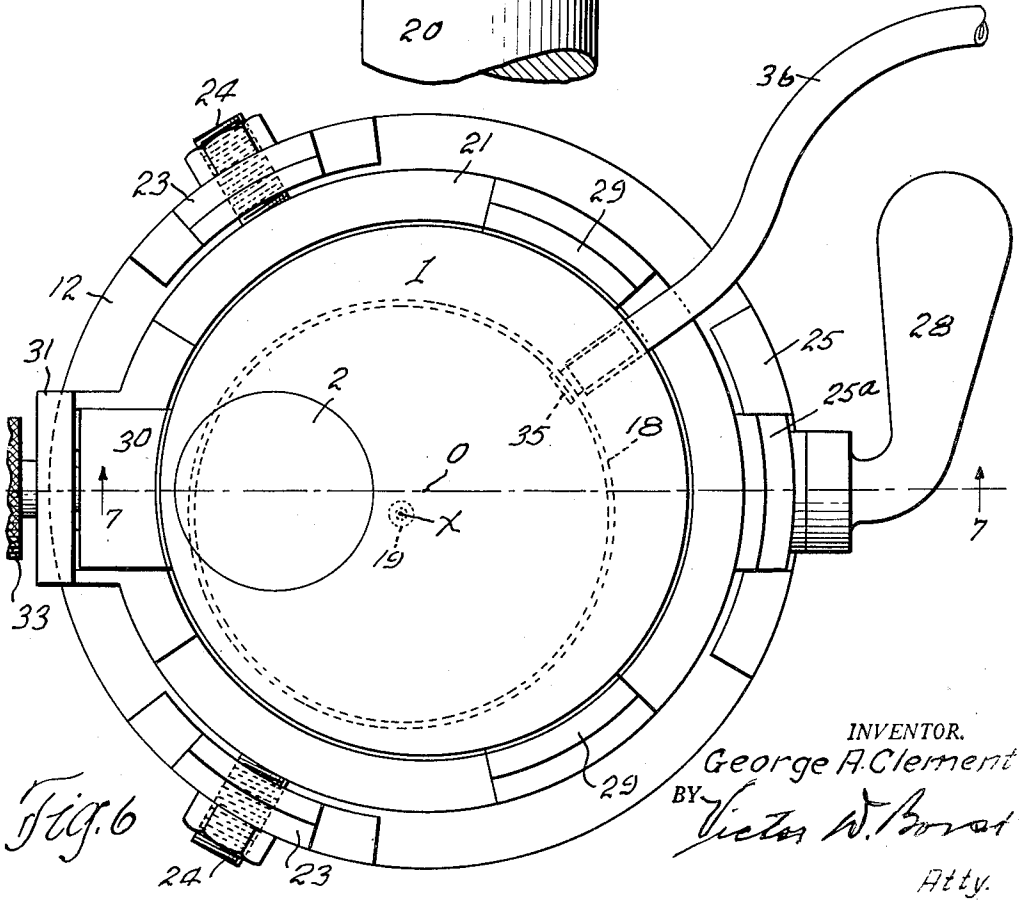


Fig. 6

INVENTOR.
George A. Clement
BY Victor W. Bonat
Atty.

Patented Mar. 20, 1951 2,545,448

UNITED STATES PATENT OFFICE

2,545,448

APPARATUS FOR GRINDING LENSES

George A. Clement, Mount Vernon, N. Y., assignor to General Optical Company, Inc., Mount Vernon, N. Y., a corporation of New York

Application June 27, 1947, Serial No. 757,627

4 Claims. (Cl. 51—131)

1

This invention relates to the art of lens grinding, particularly ophthalmic or spectacle lenses. While the invention is applicable to both single and multiple vision lenses, it has a special utility in connection with bifocal lenses and will be described and explained as it is applied in the production of such lenses, especially of the meniscus type.

Fused bifocal lenses very generally have the reading insert or segment fused into a recess on the plus or convex side, and it is common commercial practice for the manufacturer of the blanks to finish this bifocal or plus side of the blank to the final optical surface on one of the standard base curves. Such blanks are said to be semi-finished and the grinding and polishing of the surface on the other or minus side of the blank to satisfy the prescription is subsequently done. The blanks are commonly circular in form.

The optical center of the finished lens, in the case of bifocals especially, is commonly displaced from the geometric center of the blank, ordinarily being located below the horizontal meridian of the blank and to one side of the vertical meridian so as to set in the reading segment of the final lens somewhat. The location of the optical center of the finished lens depends, of course, upon the disposition of the spherical centers of the two opposing surfaces and hence upon the attitude of the blank with respect to the grinding axis during the generation of the prescription curvature.

As is well known, the common procedure in the generation of the prescription surface is to mark a spot on the finished surface to denote the location of the optical center, and then to chip or break off the edge of the blank in one or both meridians to bring the location equidistant from the ends of the meridians. At that stage, the edge of the blank is of uneven thickness at the ends of the meridians, and it is necessary to present the blank to the grinding tool in the subsequent grinding of the prescription or minus side so that the edge of the blank becomes of even thickness at the four points corresponding to the ends of the meridians. This requires localizing of the grinding pressure and frequent removal of the blank and measuring of the thickness at the meridian ends with calipers.

Such procedure is manifestly very slow and not only involves the loss of time due to the frequent removal and measuring of the blank during the generating process, but also the danger of damaging the finished surface due to the fine particles of glass which result from the chipping

2

or crumbing, as it is called, adhering to that surface and scratching it, and there is also the danger of the lens flying off the grinding tool and breaking in this operation.

The present invention aims to improve on this procedure. The need for chipping or crumbing the edges of the blank before grinding the second side is eliminated, as is the need for measuring the edge thickness as the grinding progresses. The invention includes means for definitely and accurately locating the blank with respect to the grinding tool and retaining it in that relative position until the generating operation is finished.

In accordance with the invention, the semi-finished blank is mounted on a rotative holder the axis of which includes the spherical or generating center of the grinding tool, and which has a supporting or locating spherical surface concentric with the surface to be generated on the minus side of the blank, and angularly adjusting or tilting the blank on that surface until the radius of the finished surface that coincides with the desired optical center is brought into coincidence with the radius of the projected surface on the minus side that coincides with the desired optical center. The blank is then secured in this angular position and the grinding proceeds until the surface on the minus side is generated. If the optical center is displaced from the geometric axis, as is contemplated in the problem, the optical center will be displaced from the axis of rotation or the generating axis.

The invention also includes special apparatus to carry out the method described. Preferably the holder has a spherical surface that is concentric with the surface to be generated on the blank, the radius of which is therefore greater than the radius of the finished surface on the plus side of the blank. The blank is laid on this holder surface, either actually or virtually, with its finished convex surface on the spherical surface on the holder. Angularly the blank is so positioned that the radius of the finished face that coincides with the desired optical center is in coincidence with the radius of the holder surface that includes the optical center. The blank is clamped in this position and the grinding proceeds.

If the blank is in actual contact with the holder surface, the point on the finished surface of the blank that marks the location of the optical center, is brought into contact with the holder surface. This properly positions the blank for the surface on the minus side to be

generated about the radial line of that point as an axis.

If, as is preferred, the blank is in virtual contact with the holder surface, a ring is interposed between the blank and the holder surface, and the axis of that ring will always mark the optical center of the finished lens. The ring will be applied to the blank so that the point on the finished surface indicating the optical center is in register with the axis of the ring. Since the blank is restrained in a fixed transverse relation to the rotative axis of the holder, preferably with the axis of rotation substantially coincident with the geometric axis of the blank, the ring must be off center by the amount that the optical center is displaced from the geometric center, and this causes the blank to assume the same angular position with respect to the axis of rotation, as is the case when the said point on the finished surface of the blank is in actual contact with the holder surface.

Greater accuracy can be obtained by the use of the ring, and the ring has its axis marked by a conspicuous post so that it is easy to get the said point on the finished surface in the axis of the ring. In such condition, the engagement of the bottom plane of the ring on the holder surface automatically produces the proper attitude of the blank to generate a minus surface having the desired relation to the finished plus surface.

In one form of the invention, the ring is of the so-called vacuum type, that is, the blank properly located is attached thereto by suction, and the assembly is put into the holder, and the blank and hence the ring are thereby properly located in a transverse direction with respect to the axis of rotation to give the blank the requisite angular attitude.

If desired the suction may be dispensed with, and with the blank properly centered in the holder, the ring is adjusted on the holder surface until its axis coincides with the location of the optical center on the finished side of the blank, and with the blank resting on the ring in that location, it has the proper angular attitude. It is only necessary then to clamp it and proceed with the grinding.

The invention not only saves time and greatly facilitates the operation in the generation of the prescription surface on the desired axis, as has been pointed out, but it minimizes the skill and experience required to perform the operation successfully. The invention has other advantages and novel features which will appear from the particular description of the embodiment illustrated in the drawings, which embodiment will now be described and the invention will thereafter be pointed out in claims.

Fig. 1 is a plan or face view on enlarged scale of a standard, fused bifocal, semi-finished blank, with the location of the desired optical center indicated.

Fig. 2 is a median section of the same.

Fig. 3 is a diagrammatic view illustrating the problem in connection with a sectional diagram of the blank and positioning ring.

Fig. 4 is a diagrammatic view showing the elements of Fig. 3 mounted in operative relation with respect to the holder and grinder.

Fig. 5 is an exploded view on reduced scale in side elevation and partly in section, showing the three members of the apparatus, to wit, the ring, the chuck in which the ring is clamped, and the holder in which the chuck is clamped.

Fig. 6 is a plan of the apparatus on the scale of Figs. 1 to 4, inclusive.

Fig. 7 is a sectional elevation of the same, on the plane of line 7—7 of Fig. 6.

A typical fused bifocal lens blank is shown in Figs. 1 and 2 in substantially double the normal size. The major blank member 1 is of crown or similar optical glass of a relatively lower index of refraction, while the minor blank member or segment 2 of glass having a higher index of refraction is fused into a spherical recess formed in the plus or convex side of the blank. To produce the semi-finished blank, this side, which is known as the bifocal side, is first ground and polished to a finished optical surface 3 of a selected base curve. It is to the grinding or generating of the prescribed curve on the second or minus side of the blank that this invention relates.

The meniscus, semi-finished blank has a molded, rough surface 4 on its concave or minus side, which, as shown, may be spherical and have its center of curvature on the geometrical central radius of the finished surface 3. Fig. 3 so shows it. The radial line 5 intersects the geometrical central point *o* of the surface 3 and also the spherical center 6 of the surface 3 and the spherical center 7 of the rough surface 4. In other words, both surfaces of the semi-finished blank are shown as symmetrical about the line 5.

It will now be assumed that it is desired to have the optical center of the finished lens located at the point *x* instead of the point *o* of the surface 3. Then the radial line 8 becomes the optical axis, that is, the line which includes the center 6 and the spherical center 9 of the surface 10 that is to be formed on the minus side of the blank. The final lens may be cut from the finished lens blank in any desired shape, for example, in the outline indicated by the dot and dash line in the plan view.

To accomplish the generation of the surface 10, the blank is so disposed in the holder that the center 6 of the finished surface 3 is in the line 9—*x*, that is, the line 8. The method of this invention contemplates the positioning of the blank axially on the rotative holder, that is, with the point *o*, which is the geometric center, in the axis of rotation. Since the surface to be generated on the minus side has its spherical center or center of generation, say at point 9, that point 9 must of course be in the axis of rotation. Hence the line 9—*o*, that is, the broken line 11 of Fig. 3 will be the generating axis.

Fig. 4 shows diagrammatically and preliminarily the arrangement of the blank in the holder, and the way that the angular adjustment is obtained to bring the selected point *x* in the optical axis.

A holder 12 is indicated diagrammatically. The holder is provided with an annular positioning flange which is of a size to receive the blank and is coaxial with the holder, and it will be assumed that means are present to clamp the blank in the flange so that it will be rotated with the holder. The upper surface 13 of the holder is spherical about the point 9 as a center, that is, it is concentric with the surface 10 to be generated. Therefore the radius 14 of the surface 13 is greater than the radius 15 of the surface 3, and exceeds the radius 16 of the surface 10 by a function of the thickness of the finished lens plus a function of the axial spacing of surfaces 3 and 13. While not so shown, this last quantity may be zero. That is, the blank may rest directly upon the surface 13. In that case, the point on the

surface 3 that is to be in the optical center will be the point of contact between surfaces 3 and 13 and the blank will be clamped in that position. A grinding tool 17, operatively centered at point 9, will then be applied to the minus side of the blank and the holder will be rotated until the surface 10 is generated.

By operatively centered is, of course, meant that the grinder functions to produce a surface the spherical center of which is at the point designated. As shown, the grinder has a spherical surface centered at 9 and will reproduce itself. However, as is well known, the grinder may be a sharp annulus contacting the surface of the glass only in a circular line. The operative center is, nevertheless, the point where the axis of the grinder intersects the axis of rotation of the holder, in this case the point 9. It will be understood that the grinder is also rotated on its axis and is preferably disposed eccentrically to the blank so as to avoid the formation of concentric circles in the grinding. The diameter of the grinder is such that it extends from the edge of the blank across the center.

The difficulty of getting the point x precisely in contact with the surface 13 dictates that other and simpler means to obtain the desired angular disposition of the blank be used. In practice a ring 18 is interposed between the blank and the holder. This ring is of uniform height and its axis will, therefore, always coincide with the optical axis of the finished lens. In other words, the plane of contact of the ring with the surface 13 is normal to the central radius of the portion of the surface 13 which is bounded by the ring, and the plane of contact of the ring with the surface 3 is normal to the central radius of the portion of that surface which is bounded by the ring. Since those two planes of contact are parallel, those two central radii coincide.

To facilitate the positioning of the ring 18 with its axis including the designated point x, an axial post or pointer 19 is provided. For this purpose the ring is provided with a bottom and the post 19 is an axial projection upstanding from that bottom. It is small at its upper end so as to provide a well defined locating pointer or index.

When the ring is used, the point x is marked and the blank is placed on the ring with the point x over the post 19. The engagement of the ring 18 with the surface 13 automatically gives the blank the proper angular disposition for generation of the surface 10 symmetrically about line 8 with respect to the surface 3. The grinding proceeds about the axis of rotation of the holder, that is, the line 11 which includes the center 9 and point o.

The form of apparatus used commercially is shown in Figs. 5, 6 and 7. In addition to the holder and ring, the commercial apparatus includes a chuck member which facilitates the obtaining of precise axial alignment of the parts and also the replaceability of the part including the surface 13.

The holder 12 is mounted on a rotative spindle or arbor 20, and the chuck member 21 is secured on the holder, and the blank and ring assembly are secured in the chuck.

The chuck 21 is generally cylindrical and has an accurately machined bottom surface precisely normal to its axis, and the top face of the holder 12 is provided with studs 22 that are also accurately machined on their tops to a plane normal to the axis of the spindle. The axes of the holder and chuck are therefore bound to be parallel, and with proper transverse adjustment will coincide.

Such centering of the chuck on the holder is effected by arcuate clamping segments on the holder which take the place of the annular flange of Fig. 4. There are three such segments equally spaced and concentric with the axis of the spindle. Each segment is higher at its center than at its sides. Two of the segments, numbered 23, are fixed and immovable and have a radial screw stud 24 tapped therethrough and secured in adjusted position by a lock nut. The third segment 25 has its central portion 25a pivoted at its lower end and is urged out by a spring 26 and is forced in by a screw 27 tapped into the holder body and operated by a handle 28. To insert the chuck, it is set on the studs 22 when the screw 27 is retracted, and the handle 28 is then turned until the chuck is brought up tightly against the positioning studs 24. Its axis is then in line with that of the spindle.

The chuck 21 also has three upstanding arcuate segments to clamp the blank. Two of these segments 29 are fixed while a third, numbered 30, is pivoted and is adjustable to center and grip the blank. The clamping segment 30 is disposed and pivoted within a housing extension 31 on the chuck, and a spring 32 urges the pivoted segment out, while a manually operated screw 33 is threaded through the outer wall of the housing and bears against the pivoted segment and forces it in against the stress of the spring. When the blank is present and the screw 33 is set up, the blank is gripped and clamped by the segments 29 and 30, as shown in Figs. 6 and 7, when the point o is in the axis of rotation. The segments 29 and 30 are preferably faced with leather or fiber or the like to protect the edge of the blank from injury by the segments.

The chuck has a removable bottom member 34 which is provided with the selected face 13. When the operation calls for a change in power of the generated surface, the bottom member 34 is changed accordingly to keep the surface 13 in agreement with the surface 10, that is, concentric therewith.

The ring 18 is a simple, cup-shaped member somewhat smaller in diameter than the blank, and it has its top edge bevelled off to provide a sharp edge for the blank to rest upon. The positioning of the ring relative to the blank may be accomplished in different ways. For example, it may be a vacuum cup and is so shown. In this form it has a nipple 35 in the side wall, and a flexible tube 36 is attached to the nipple and provides a communication from the interior of the ring to a suction means. In such case, the blank and ring may be assembled outside the chuck where it is easy to bring the point x over the post 19, and suction be then applied to the tube 36. This will cause the blank and ring to be immovably related with sufficient security, and the tube can be pinched to hold the reduced internal pressure and the assembly be inserted in the chuck and the blank be clamped. The blank is thus given the right angular attitude.

Another way is to place the ring on the chuck without regard to its location, and then to set the blank in the chuck on the ring and adjust the ring until the point x and the post 19 coincide. Then after slight downward pressure is exerted on the blank to make sure that it is in firm engagement with the ring, preferably pushing at the location of the spot x and hence along the axis of the ring, the screw 33 is set up and the

blank is clamped. Either procedure will bring the blank into an attitude relative to the axis of rotation such that the post 19 marks the optical center of the finished lens.

It will be understood that the method and apparatus herein described are applicable to the generation of toric as well as spherical surfaces. Therefore, reference herein to the spherical center of the surface to be generated is not intended to exclude the possibility of relative movement of the tool and blank to introduce a cylindrical axis in the generated surface, but is intended to indicate the point of intersection of the axis of the tool with the axis of rotation of the blank; and the definition of the spherical supporting surface on the holder as concentric with the surface to be generated is intended to denote that the said intersection point is the spherical center of said surface.

It is obvious that the method may be carried out by other apparatus than that shown in the drawings and above particularly described, and it will be understood that the invention is not limited to the details of construction but may be otherwise embodied within the spirit of the invention and the scope of the following claims.

What is claimed is:

1. A mechanism for mounting meniscus lens blanks finished on their plus sides to generate lenticular surfaces on their minus sides, comprising a rotative holder having a supporting surface thereon concentric with the surface to be generated, a cup shaped ring having an attachment to its side for exhausting the air therefrom and adapted to receive the finished side of a blank and hold the blank in fixed relation thereto when the internal pressure is reduced and to rest and be variously located upon the said supporting surface, and clamping means on the holder arranged to receive the blank and permit it to assume an angular position relative to the axis of rotation determined by the location of the ring on said surface and to clamp the blank in such position.

2. A mechanism for generating a surface on the minus side of a meniscus lens blank finished on the plus side, comprising a rotatable holder, a removable chuck secured to the holder and having a concave spherical surface symmetrical with respect to the axis of rotation, a ring loosely disposed on said chuck surface and free for universal movement thereon and adapted to have the finished side of the lens blank rest on it, the spherical center of the chuck surface being disposed on the axis of rotation substantially beyond the supporting edge of the ring, clamping means on the chuck arranged to receive the blank and permit it to assume an angular position relative to the axis of rotation determined by the location of the ring on the chuck surface and to clamp the blank in such position, and a rotative annular grinding tool applicable to the minus side of the blank and having its axis of rotation intersecting the axis of rotation of the holder at the spherical center of the chuck surface.

3. A mechanism for generating a surface on the minus side of a meniscus lens blank finished on the plus side, comprising a rotatable holder, a removable chuck secured to the holder and having a concave spherical surface symmetrical with respect to the axis of rotation, a ring member having its bottom closed and an attachment to its side for exhausting the air therefrom, said ring member being loosely disposed on said chuck surface and free for universal movement thereon and adapted to have the finished side of the lens blank rest on its open edge, the spherical center of the chuck surface being disposed on the axis of rotation substantially beyond the supporting edge of the ring, clamping means on the chuck arranged to receive the blank and permit it to assume an angular position relative to the axis of rotation determined by the location of the ring on the chuck surface and to clamp the blank in such position, and a rotative annular grinding tool applicable to the minus side of the blank and having its axis of rotation intersecting the axis of rotation of the holder at the spherical center of the chuck surface.

4. A mechanism for generating a surface on the minus side of a meniscus lens blank finished on the plus side, comprising a rotatable holder, a removable chuck secured to the holder and having a concave spherical surface symmetrical with respect to the axis of rotation, a ring member having its bottom closed and an attachment to its side for exhausting the air therefrom, said ring member being loosely disposed on said chuck surface and free for universal movement thereon and adapted to have the finished side of the lens blank rest on its open edge, an axial post upstanding from the bottom of the ring member, the spherical center of the chuck surface being disposed on the axis of rotation substantially beyond the supporting edge of the ring, clamping means on the chuck arranged to receive the blank and permit it to assume an angular position relative to the axis of rotation determined by the location of the ring on the chuck surface and to clamp the blank in such position, and a rotative annular grinding tool applicable to the minus side of the blank and having its axis of rotation intersecting the axis of rotation of the holder at the spherical center of the chuck surface.

GEORGE A. CLEMENT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 13,954	Scheurle	July 27, 1915
978,764	Lincoln	Dec. 13, 1910
1,075,714	Hornig	Oct. 14, 1913
1,224,169	Hice	May 1, 1917
1,260,022	Paige	Mar. 19, 1918
1,282,037	Bugbee	Oct. 22, 1918
1,467,308	Clement et al.	Sept. 11, 1923
2,096,751	Martin	Oct. 26, 1937
2,310,925	Bardwell et al.	Feb. 16, 1943