

May 29, 1956

G. C. SCHELLING
LENS GRINDING MACHINE

2,747,339

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2 Sheets-Sheet 1

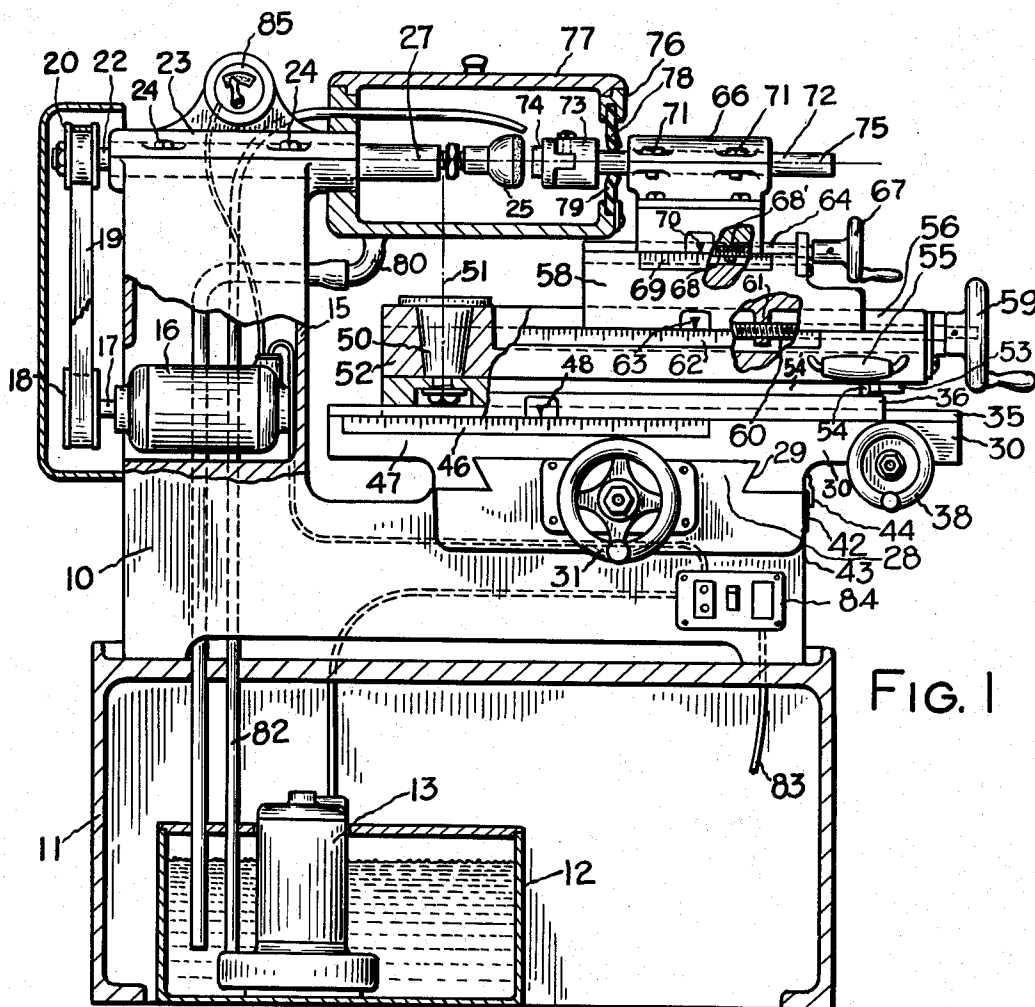


FIG. 1

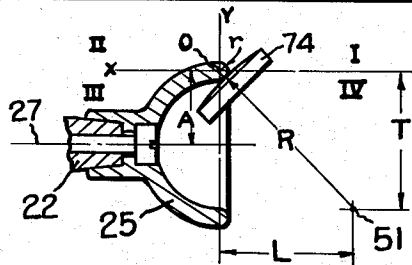


FIG. 4

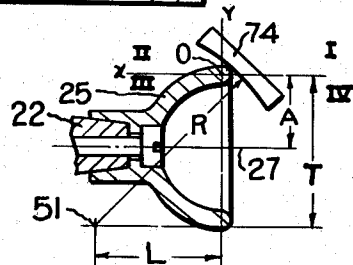


FIG. 5

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FIG. 2

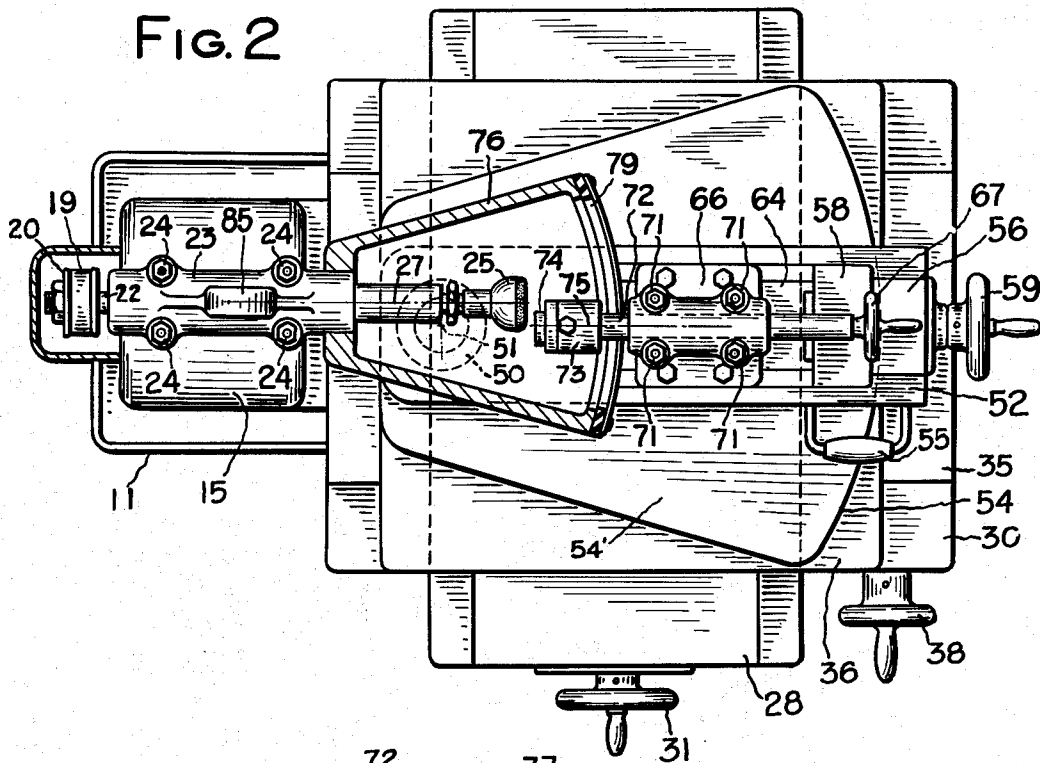
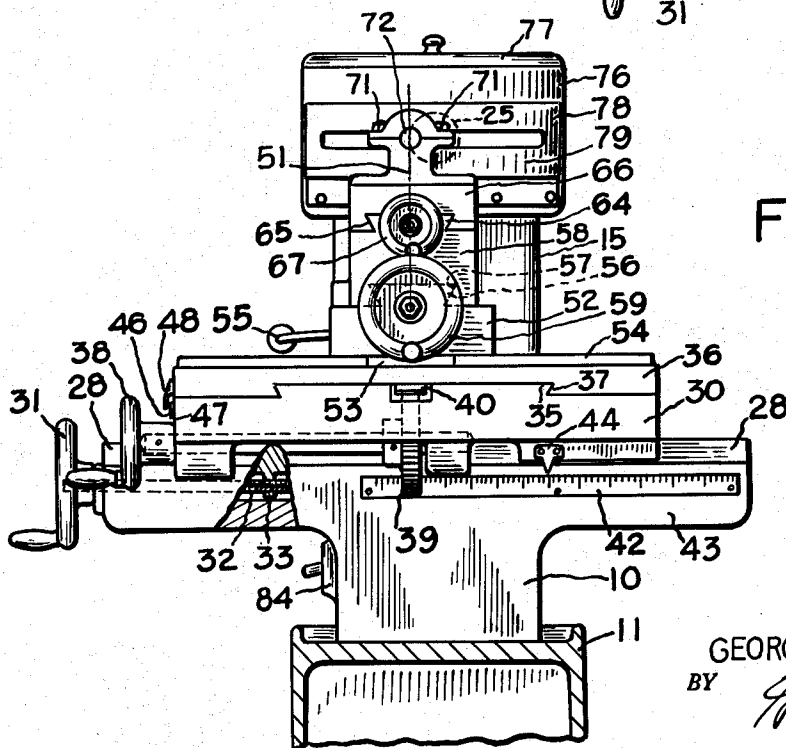


FIG. 3

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LENS GRINDING MACHINE

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5 Claims. (Cl. 51—124)

This invention relates to lens grinding methods and machines, and more particularly it has reference to an improved machine and method for producing toric surfaces on lenses.

Toric generators of the character herein referred to have a rotating cup type grinding member and a non-rotating lens member adapted to be brought into grinding contact as they are moved relative to each other in an arcuate path to produce a toric surface on said lens member. Heretofore, toric generators of the character described have required means for adjusting both the lens member and the grinding member relative to each other in order to produce a surface of the desired type and curvature. These adjustments usually require motions that are both angular and rectilinear. Some more recent designs have adopted the principle of using only adjustments that require rectilinear motions, but these designs still require that both the grinding member and the lens member be adjusted relative to each other.

Therefore, the primary object of this invention is to provide an improved toric generator of the character described in which all necessary adjustments are made on only one member.

Another object of this invention is to provide an improved toric generator of the type described in which the necessary adjustments are made on a single member and in rectilinear paths so that a relatively simple structure is involved.

A further object of this invention is to provide an improved method for generating a toric surface on a lens blank.

And a still further object of this invention is to provide an improved toric generator that can be produced more cheaply and efficiently than current machines.

To these and other ends, the invention resides in certain features and advantages of construction, arrangement and combination of parts and in certain method steps as will hereinafter be described, the novel features being pointed out in the appended claims.

Referring to the drawings:

Fig. 1 is a front elevation of a toric generator embodying my invention with some parts shown broken away and in section.

Fig. 2 is a top view of the machine with some parts shown in section.

Fig. 3 is an end view of the machine with some parts shown in section.

Fig. 4 is a diagrammatic view through the horizontal plane of the grinding wheel showing its relation to the lens blank when producing a convex surface.

Fig. 5 is a similar view showing the relation of the parts when producing a concave surface.

Referring more particularly to the drawings, wherein like reference numerals refer to like parts, a frame 10 is supported on a base 11 which encloses a coolant supply reservoir 12 in which a pump 13 is mounted for a purpose to be more fully disclosed later.

One end portion of the upper side of the frame 10 has

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an upwardly projecting hollow housing 15 in which is mounted an electric motor 16 having a spindle 17 receiving a pulley 18 for driving a belt 19. A second pulley 20, driven by said belt 19, is attached to one end of the shaft 22 which is rotatably journaled in a recess on the upper end of the housing 15 by the bearing cap 23 held by bolts 24. The other end of the shaft 22 is provided with an annular or cup type grinding wheel member 25 mounted to rotate with the shaft 22 about a horizontal axis 27 extending longitudinally of and being fixed relative to said frame 10. The horizontal position of the grinding face of the wheel along said horizontal axis being fixed relative to said frame so that the arcuate grinding face of said wheel will be tangent to a vertical plane lying perpendicular to said horizontal axis. The position of said vertical plane being fixed relative to said frame. The construction of the frame 10 and housing 15 is such as to rigidly support the motor 16, shaft 22 and grinding wheel 25 with respect to the base 11. Since said motor, shaft and grinding wheel are not moved relative to the frame, except for rotation of the shaft and grinding wheel about the horizontal axis of the shaft, there is no need to correct said motor and grinding shaft for angular thrust created when, as in prior machines, the motor and shaft are movably and adjustably mounted on said frame. Heavier bearings and more permanent mountings are permitted by this fixed structure so that one of the principal defects of prior machines is removed, namely, lost motion and loose bearings in the adjustments of the heavy movable motor mounts due to the continual wear created by the movement of the motor.

The frame 10 is provided with a track 28 extending transversely with respect to the horizontal axis 27 of the grinding wheel 25 in cooperating relation with a dovetail slide 29 in a sub-carriage 30. Movement of the sub-carriage 30 along a transverse path on the track 28 is obtained by means of a handwheel 31, a worm gear 32 and a threaded lug 33 which depends from sub-carriage 30. The upper side of the sub-carriage 30 is provided with a track 35 along which carriage 36 slides, guided by cooperating dovetail slide 37, under the drive of handwheel 38, pinion 39 and rack 40 (Fig. 3). The movement of the carriage 36 along a longitudinal path substantially parallel to the horizontal axis 27 of the grinding wheel is exactly at right angles to the path of transverse movement of the sub-carriage 30. Since the carriage 36 is mounted on the sub-carriage 30, transverse movement of said sub-carriage moves said carriage transversely a like amount. Therefore, throughout this specification and in the attached claims, all movement of the sub-carriage will be treated as movement of the carriage.

A scale 42, having a zero value at its center and being graduated outwardly in opposite directions, is secured on the side 43 of the frame 10 and has its reading edge aligned with an index marker 44 mounted on the adjacent edge of the sub-carriage 30. A scale 46, having a zero value at its center and being graduated outwardly in opposite directions, is secured on the front edge 47 of the sub-carriage 30 and has its reading edge aligned with an index marker 48 mounted on the front side of the carriage 36.

Secured to and upwardly projecting from the top of the carriage 36 is a tapered bearing member 50 which provides a vertical axis of swing 51 which is perpendicular to the horizontal plane of the fixed horizontal axis 27 of the grinding wheel 25.

The grinding wheel 25 has an arcuate grinding surface or face with a pitch circle extending therearound which is the locus of centers of all radii of curvature for said grinding surface. The horizontal plane passing through the fixed horizontal axis 27 and lying perpendicular to the

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vertical axis of swing 51 intersects the pitch circle of the grinding portion of the grinding wheel at a center of curvature O of Figs. 4, 5. When said vertical axis of swing 51 passes through said center of curvature O, the index markers 44 and 48 will be aligned with the zero readings on the scales 42 and 46 of the sub-carriage 39 and carriage 36, respectively. Any longitudinal or transverse movement of the carriage 36 will move the vertical axis of swing 51 relative to said center of curvature O an amount indicated on the scales 42 and 46 for a purpose to be later described.

Mounted on the carriage 36 to turn on bearing 50 about said vertical axis of swing 51 is a turntable 52 having a depending lip 53 engaging with an arcuate track 54 formed on a plate 54' carried by the top surface of the carriage 36. Mounted on one lateral side of the turntable 52 is a handle 55 which may be gripped by an operator for swinging the turntable about said bearing 50 and axis of swing 51. The upper face of the turntable 52 has a track 56 cooperating with a dove-tail slide 57 in the lower portion of a slide element 58. Radial movement of said slide element 58 along said track 56 relative to said vertical axis 51 is effected by means of hand-wheel 59, worm gear 60 and threaded lug 61 depending from said slide 58 (Fig. 1). A scale 62 is secured on the side of the turntable 52 and has its reading edge aligned with an index marker 63 mounted on the side of the slide element 58.

Each longitudinal and transverse setting of the carriage 36 positions the vertical axis of swing 51 a predetermined radial distance from the edge of the grinding wheel in accordance with the selected type and amount of curvature to be generated by said grinding wheel on the lens blank. Therefore, for each longitudinal and transverse setting of the carriage, the slide element 58 must be moved on the turntable 52 a corresponding radial distance from the axis of swing 51 for positioning the lens blank relative to the grinding wheel. The radial distance moved by said slide element 58 is indicated on the scale 62 by the marker 63.

The upper side of the slide element 58 has a track 64 cooperating with a dove-tail slide 65 in the lower portion of a lens blank support 66. Radial adjustment of said lens blank support 66 along said track 64 relative to the slide element 58 and said vertical axis of swing 51 is effected by means of hand wheel 67, worm gear 68 and threaded lug 68' depending from said support 66 (Fig. 1). A scale 69 is secured on the side of the slide element 58 and has its reading edge aligned with an index marker 70 mounted on the side of the lens blank support 66. Fastened by means of bolts 71 upon the lens blank support 66 is a shaft 72 having a chuck 73 on one end which holds a lens blank 74 in fixed non-rotating position about its horizontal axis 75. The fixed horizontal axis 27 of the grinding wheel and the horizontal axis 75 of the lens blank lie in the same horizontal plane which is perpendicular to the vertical axis of swing 51.

As shown in Figs. 4 and 5, the cup type grinding wheel 25 has an arcuately curved abrading surface with its center of curvature at O where the x and y coordinate axes intersect. By making transverse movements T and longitudinal movements L of the carriage 36, the axis of swing 51 may be selectively positioned so as to produce a desired radius of swing R. Since the lens blank 74 is moved across the abrading surface of the wheel 25 in an arcuate path having the radius R, the base curve of the toric surface formed on the lens blank 74 will have its radius of curvature equal to R. The amount of curvature in the cross curve of the toric surface, formed on the lens blank 74, will be determined by the radius A of the grinding wheel 25 and by the position of the vertical axis of swing 51 with respect to the x axis.

For generating a convex surface on the lens blank 74, the axis of swing 51 is positioned in the fourth quadrant, as shown in Fig. 4, and, when a concave surface is de-

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sired, the axis of swing 51 is positioned in the third quadrant, as shown in Fig. 5.

It will be noted that the distances T and L are measured from the center of curvature O of the grinding face of the grinding wheel. It will also be noted that the actual grinding of the toric surface takes place at an edge of the grinding face, a distance equal to the radius of curvature r of said grinding face from the point of actual measurement. This condition results from the necessity of taking all measurements from a fixed point (O), instead of from a variable surface such as the continually wearing away grinding surface of the grinding wheel. The error introduced in the radius of curvature R is less than the radius r. A chart, supplied with each machine, is computed and laid out to correct the distances T and L for this error.

To prevent the liquid abradant compound and the waste material from the grinding wheel from spattering onto the machine and the operator, a chamber 76 is rigidly mounted on the housing 15 for enclosing the grinding wheel and lens blank. A removable cover 77 is secured over the open top of the chamber 76 which has two yieldable rubber aprons 78, 79, one extending upwardly, the other downwardly, over the open end of the chamber in such a way as to partially encase the shaft 72 of the lens blank support. A drain 80 extends from the lower portion of the chamber 76 back to the reservoir 12 which has a tube 82 running from the pump 13 through the chamber 76 and into position to discharge liquid abradant onto the grinding surface of the grinding wheel and lens blank.

An electric circuit 83, connected through the switch panel 84 to the pump 13 and the motor 16, provides a source of power to drive the pump and the grinding wheel. An ammeter 85 is connected to the motor 16 in such a way that an overload on the motor will be indicated by a pointer lying in a red zone on said ammeter. Such an overload may be caused by an excessive drag on the motor created by a dull or worn grinding wheel.

In the operation of the machine, a lens blank 74 is held in the chuck 73 on the lens blank support 66 and when so held the axis 75 of the blank and support lies in the horizontal plane passing through the horizontal axis 27 of the grinding wheel. Each machine is supplied with a chart for use by the operator in determining the various adjustments of the lens blank needed to produce toric surfaces of various curvatures. For a lens having a desired surface, the chart is consulted to determine the transverse and longitudinal settings which should be made on the carriage 36. The transverse and longitudinal movements of carriage 36 are made by handwheels 31 and 38, respectively, and the settings are determined by scales 42 and 46, respectively. These two adjustments of the carriage longitudinally and transversely of the frame 10 position the vertical axis of swing 51, which is fixed relative to said carriage, relative to said grinding surface of the grinding wheel 25. If a convex surface is desired, the longitudinal adjustment is made so as to place the axis of swing 51 in the fourth quadrant, as shown in Fig. 4, and if a concave surface is required, the axis of swing 51 is positioned in the third quadrant, as shown in Fig. 5. After the axis of swing 51 is set, the operator adjusts the slide element 58 radially, relative to the vertical axis of swing 51 on the turntable 52, by means of handwheel 59, scale 62 and index marker 63. The setting of the marker 63 on the scale 62 will be the radius of swing of the lens blank 74 about the axis 51. The blank should just touch the edge of the grinding wheel after this setting is made. An alternate method of making this adjustment would be for the operator to crank the handwheel 59 until an edge of the lens blank 74 just touches one edge of the grinding wheel 25. The final adjustment is for depth of cut on the lens blank which is accomplished by first noting the reading on scale 69 when the lens blank just touches the grind-

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ing wheel. Since the amount of material to be removed from the lens blank is known, this amount is subtracted from the reading on scale 69. Using handwheel 67, the newly determined value is set on scale 69. The turntable is swung about the axis of swing 51 for sweeping the lens blank 74 in contact with and across the face of the rotating grinding wheel 25 whereby a toric surface is generated on the lens blank. If the amount of material to be removed appears to be too great for one cut, the material can be removed more gradually by advancing the support 66 and lens blank 74 in steps thereby removing only a portion of the material each time until the final surface is generated.

Substantial improvements in the method and machine for generating toric surfaces are effected by my invention which requires that the axis of either the lens member or grinding member be fixed and that all adjustments of the member whose axis is not fixed be made in linear paths. Thus, in the embodiment disclosed in the drawings, the axis of the grinding wheel is fixed and the axis of swing of the lens is moved in linear paths in making necessary adjustments relative to the grinding member. It is readily apparent that fixing one member, such as the rotatable grinding wheel, removes one of the potential sources of error in setting a particular curve on the machine for the more members to be adjusted the more likely errors will be introduced. By making all of the adjustments on the lens blank member simple, the unit time required for setting each curve is materially reduced and the number of units produced is materially increased. Since it is easier and cheaper to produce the mechanical elements needed for the straight line movements, the resulting cost of the machine is substantially reduced.

From the foregoing, it will be apparent that I am able to attain the objects of my invention and provide an improved and efficient toric generator of the character described in which only one member is adjusted while the axis of the other member is fixed relative to the frame. All of the adjustments on the adjustable member are made along straight line rectilinear paths which are simple and accurate. The method of generating a curved surface on the lens blank, using my improved machine, is more efficient. Various modifications can obviously be made without departing from the spirit of my invention as pointed out in the appended claims.

I claim:

1. In a lens grinding machine the combination of a frame an annular cup type grinding wheel mounted to rotate about a horizontal axis fixed relative to said frame and extending longitudinally thereof, said grinding wheel having an arcuate grinding surface with a pitch circle extending therearound which is the locus of centers of the radius of curvature for said grinding surface, said grinding surface having a plane passing through said locus of centers perpendicular to the horizontal axis of the grinding wheel and parallel to a plane lying tangent to the foremost portions of the grinding surface, a carriage movably mounted on the frame, a turntable movably mounted on said carriage to turn about a vertical axis fixed with respect to the carriage, means for moving said carriage longitudinally and transversely of said frame for positioning said vertical axis relative to said grinding surface, a slide element on said turntable radially movable relative to said vertical axis, and a lens blank support movably mounted on said slide element to move a fixedly mounted lens blank radially relative to said vertical axis and in position to be engaged by the grinding wheel, whereby the vertical axis may be positioned relative to the grinding wheel in accordance with the selected type and amount of curvature to be generated on the lens blank by the grinding wheel when the turntable is swung about said vertical axis.

2. In a lens grinding machine the combination of a frame, a cup type grinding wheel having an arcuate grinding surface mounted to rotate about a horizontal axis

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fixed relative to said frame and extending longitudinally thereof, the arcuate grinding surface of said grinding wheel being tangent to a fixed vertical plane lying perpendicular to said horizontal axis, a carriage mounted on said frame, means for moving the carriage longitudinally on said frame, means for moving said carriage transversely on said frame, a turntable movably mounted on said carriage to turn about a vertical axis fixed with respect to said carriage, a slide element mounted on said turntable radially movable relative to said vertical axis and a support for fixedly holding a lens blank in position to be engaged by the grinding wheel, said support being movably mounted on said slide element to move radially relative to said slide element and to said vertical axis, whereby longitudinal and transverse movements of the carriage will position the vertical axis relative to the grinding wheel and adjustment of the slide and support relative to the vertical axis will position the lens blank relative to the grinding wheel so that swinging the turntable about the vertical axis will sweep the lens blank in contact with and across the face of the grinding wheel to generate a surface of selected curvature on said lens blank.

3. In a lens grinding machine the combination of a frame, a cup type grinding wheel mounted to rotate about a horizontal axis fixed relative to said frame and extending longitudinally thereof, the arcuate grinding surface of said grinding wheel being tangent to a fixed vertical plane lying perpendicular to said horizontal axis, a carriage movably mounted on said frame, a turntable mounted on said carriage to turn about a vertical axis fixed with respect to said carriage, a slide element movably mounted on said turntable, a workpiece fixedly mounted on said element, means for moving said carriage on the frame for positioning said vertical axis relative to the grinding wheel in accordance with the type and amount of curvature to be generated on the workpiece comprising means for moving the carriage to adjustably position the vertical axis along a plane which is perpendicular to said horizontal axis, means for moving the carriage to adjustably position the vertical axis along a vertical plane which is parallel to said horizontal axis, and means for moving the element and workpiece on said turntable radially of said vertical axis for setting the radius of swing of the workpiece about said vertical axis whereby the position of the vertical axis relative to the grinding surface will determine the amount and type of curvature generated on the lens blank.

4. In a lens grinding machine the combination of a frame, an annular cup type grinding wheel, a horizontal shaft rotatably carried by the frame, said wheel being secured to one end of the shaft, the horizontal axis of the shaft being fixed relative to the frame, a carriage mounted for longitudinal and transverse movements on the frame below the plane of said shaft, a vertical bearing member fixedly carried at the end of the carriage adjacent said shaft, a turntable mounted to swing about said bearing member on the carriage, a slide element mounted to move on the turntable radially to the axis of said bearing member, means for holding a lens blank on the slide element in position to be engaged by the grinding wheel when the turntable is swung about said axis, and means for moving the carriage longitudinally and transversely on the frame for positioning the bearing member relative to the grinding wheel in accordance with the desired curvature to be ground on the lens blank, said shaft extending inwardly from the edge of the frame and overhanging a part of the carriage whereby the bearing member may be selectively positioned forwardly or rearwardly of the grinding wheel for producing convex or concave surfaces on the lens blank.

5. In a lens grinding machine, the combination of a frame, an annular cup type grinding wheel, a horizontal shaft rotatably carried by the frame and having said

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wheel attached to one end thereof, the horizontal axis of said shaft being fixed relative to the frame, a carriage mounted for longitudinal and transverse movements on the frame, a vertical bearing member fixedly carried at one end of the carriage, a turntable mounted to turn about said bearing member on the carriage, a slide element on said turntable radially movable relative to the axis of said bearing member, a lens blank support mounted on said slide element and longitudinally movable thereon in a direction which is radial to said axis for holding a lens blank in position to be engaged by the grinding wheel when the turntable is swung about said axis, and means for moving the carriage longitudinally and transversely of the frame to selectively position the bearing member relative to the grinding wheel in accordance with the desired curvature to be ground on the lens blank,

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said shaft extending longitudinally of the frame and overhanging part of the carriage whereby the bearing member may be selectively positioned forwardly or rearwardly of the grinding wheel for producing convex or concave surfaces on the lens blank.

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