United States Patent

Oldfield et al.

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[45] **June 20, 1972**

[54] TOOL POSITIONING MEANS FOR LENS GRINDER

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[21] Appl. No.: **42,125**

[52] **U.S. Cl.** ..... **51/165.71**, 51/124 L, 51/165.72

[51] **Int. Cl.** **B24b 49/12**

[58] **Field of Search** ..... 51/165.71, 165.72, 165.9, 165.92, 51/165 R, 124 L

[56] **References Cited**

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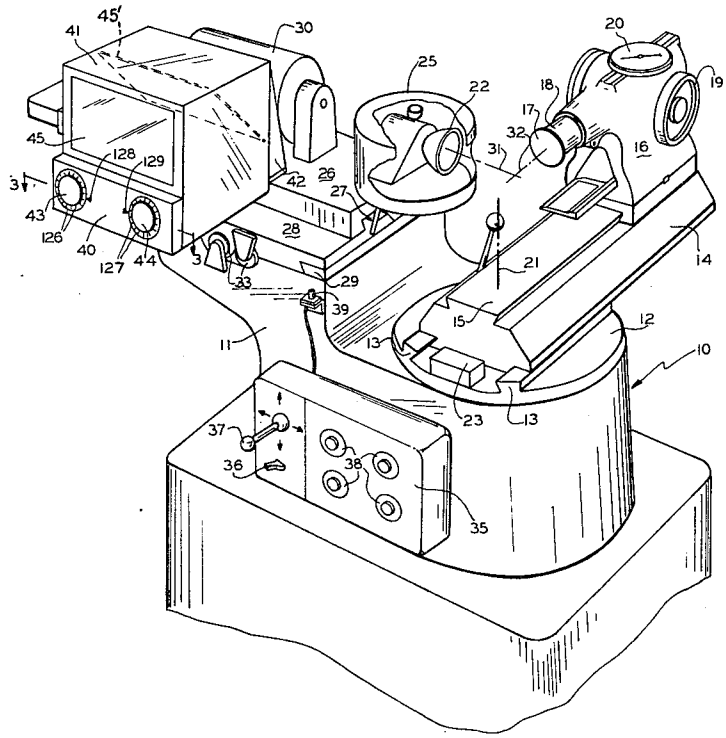
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Primary Examiner—Lester M. Swingle
Attorney—Bruns & Jenny

[57] **ABSTRACT**

A toric lens grinding machine has means for swinging a lens blank past a cup-shaped grinding wheel and in contact therewith, the wheel being mounted on crossed slides. A computer device secured to the wheel carrying slide has a transparent portion overlying an upward beam of light fixed on the machine base. The computer has first dial means marked in diopters for setting an aiming tube so as to be movable along a straight line calculated to determine the base curve of the ground lens. Second dial means marked in diopters are provided for moving the aiming tube along the straight line a calculated distance for determining the cylinder curve of the ground lens. A valve connected to hydraulic motor means for moving the crossed slides has a single lever for moving both slides so that the wheel is moved in a single direction determined by the direction the lever is moved so that the aiming tube and beam of light may be quickly aligned to position the wheel in the machine for grinding the toric lens set on the dials. The aiming tube is illuminated and a mirror overlying the computer device projects images of the tube and light beam on a translucent screen at the side of the machine.

9 Claims, 16 Drawing Figures



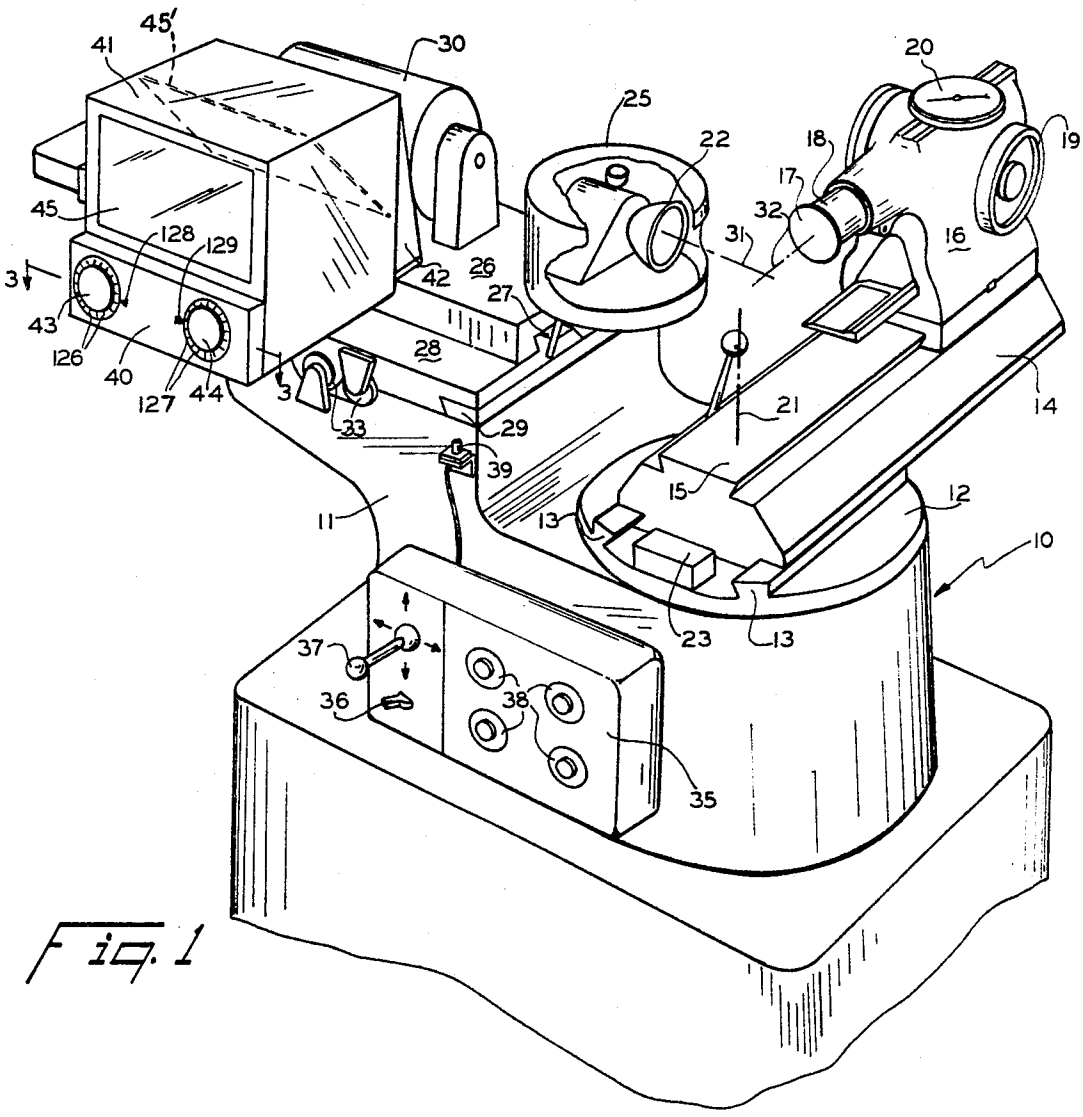


Fig. 1

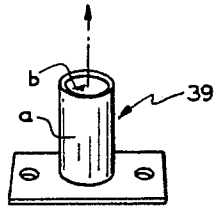


Fig. 2

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ATTORNEYS

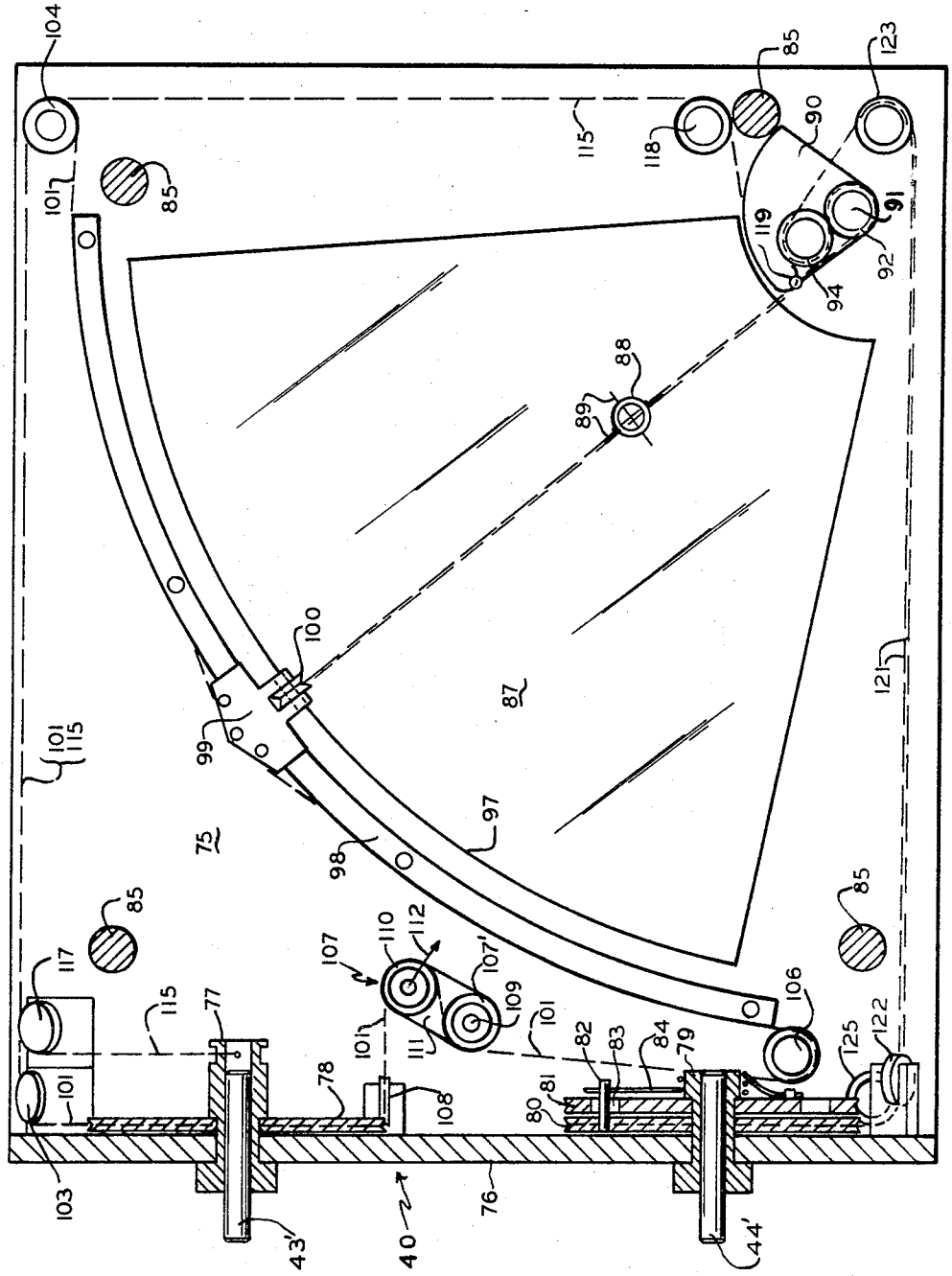

104
85
123
101
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110
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107'
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78
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81
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Fig. 3

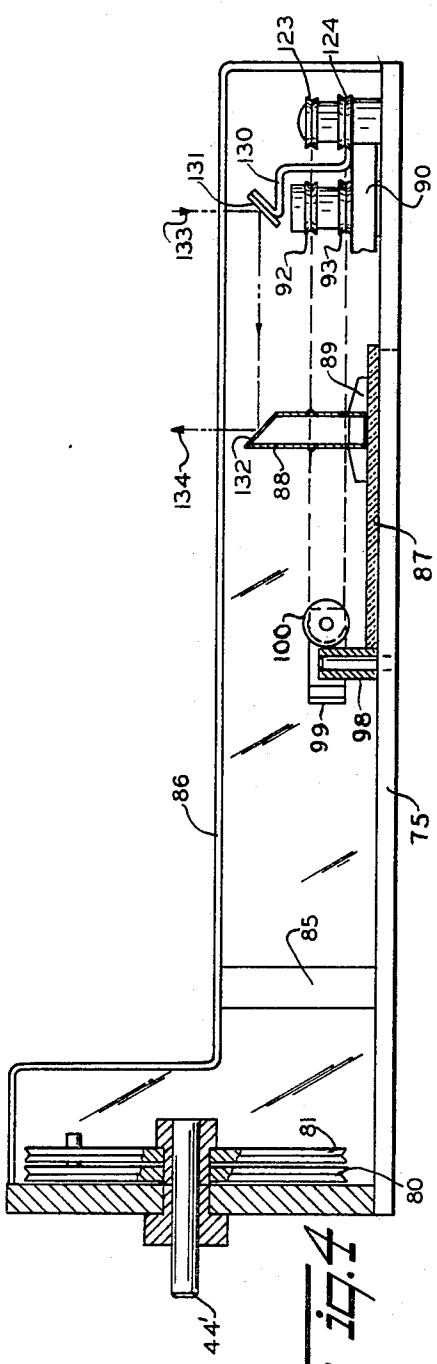


Fig. 4

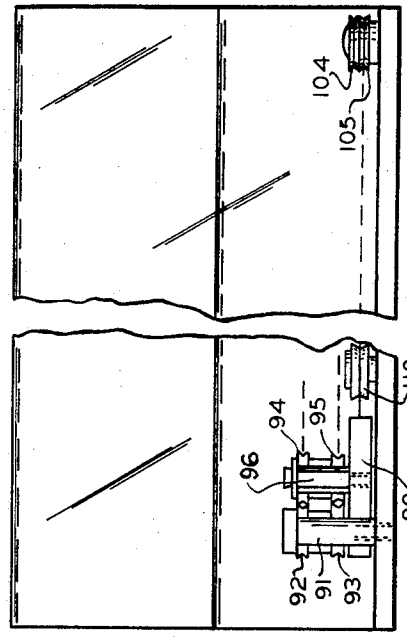


Fig. 6

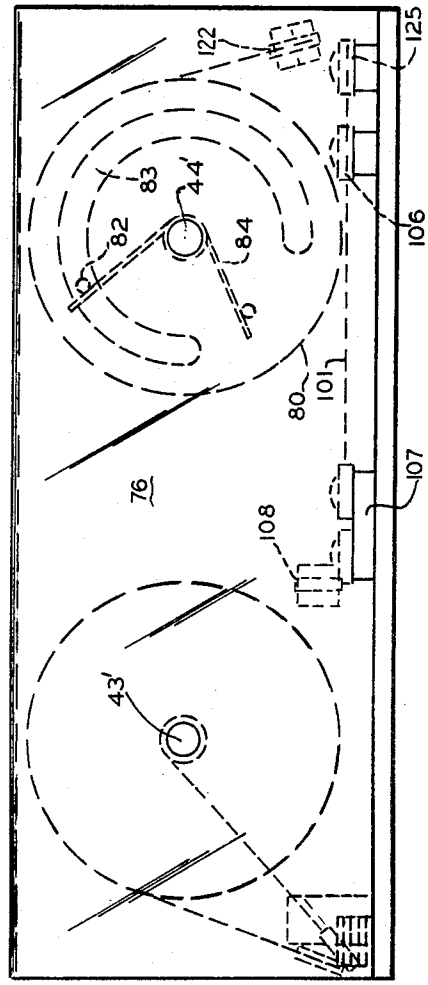


Fig. 5

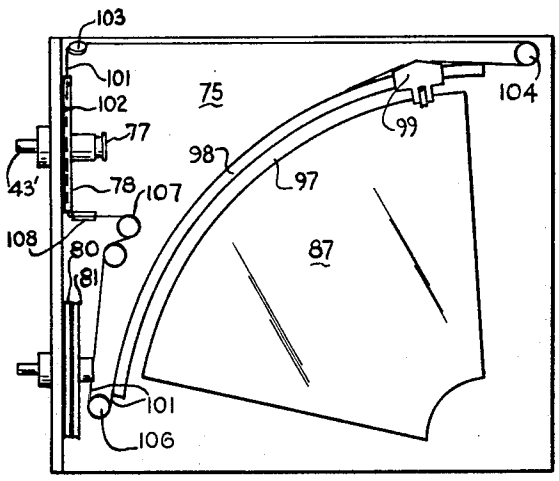


Fig. 7

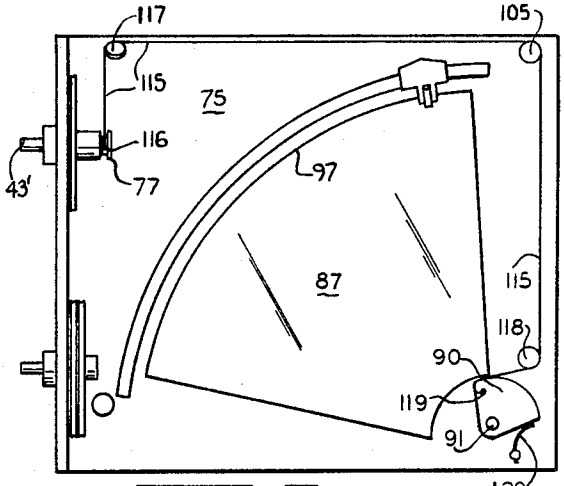


Fig. 8

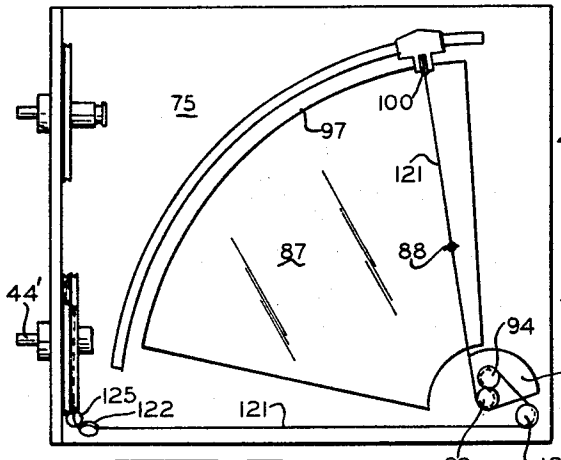


Fig. 9

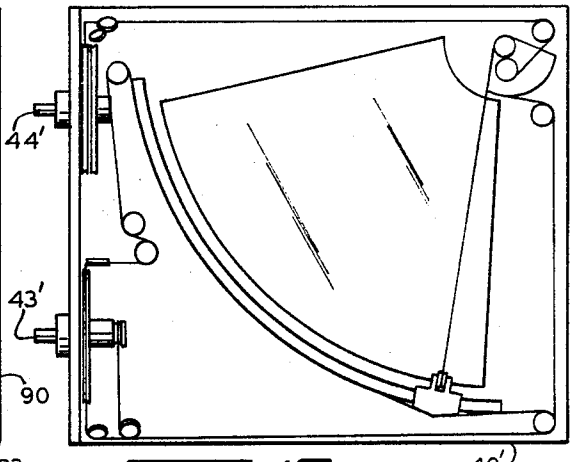


Fig. 10

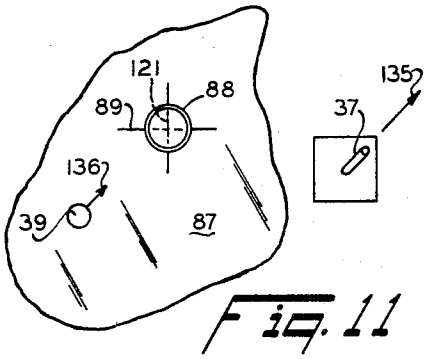


Fig. 11

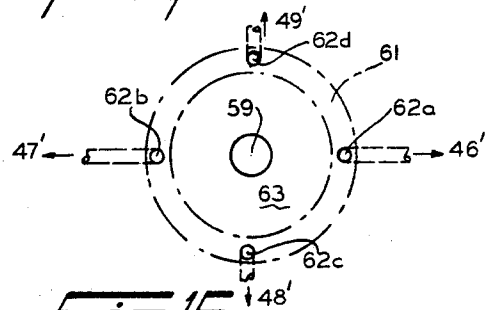


Fig. 16

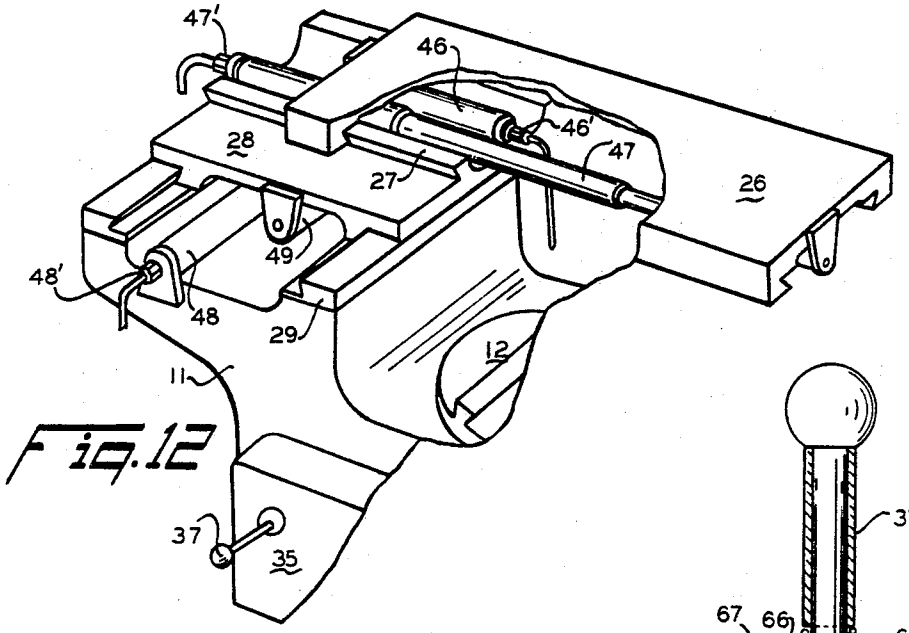


Fig. 12

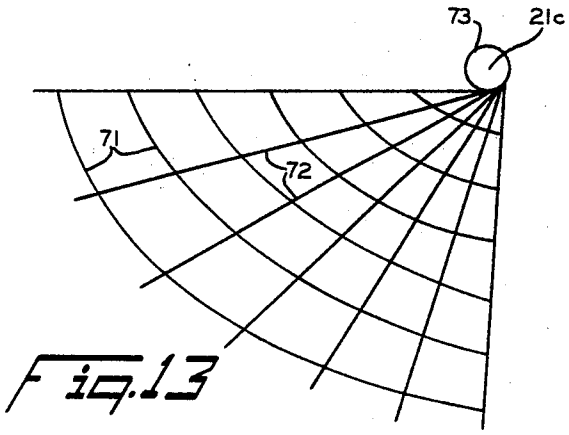


Fig. 13

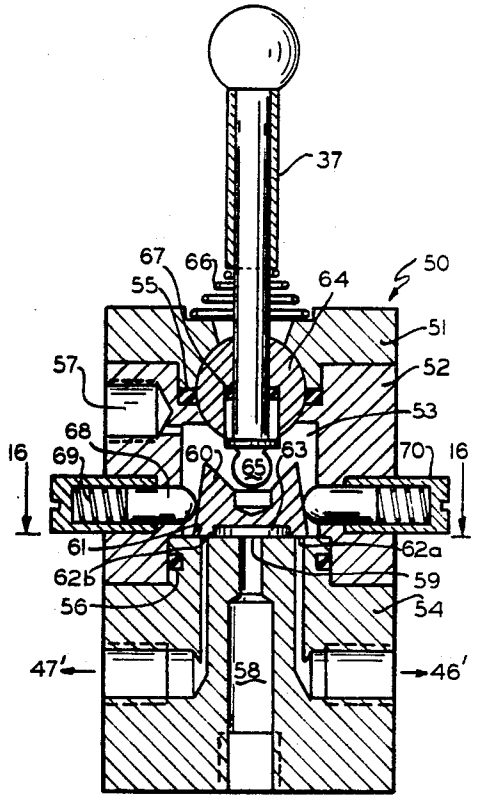


Fig. 15

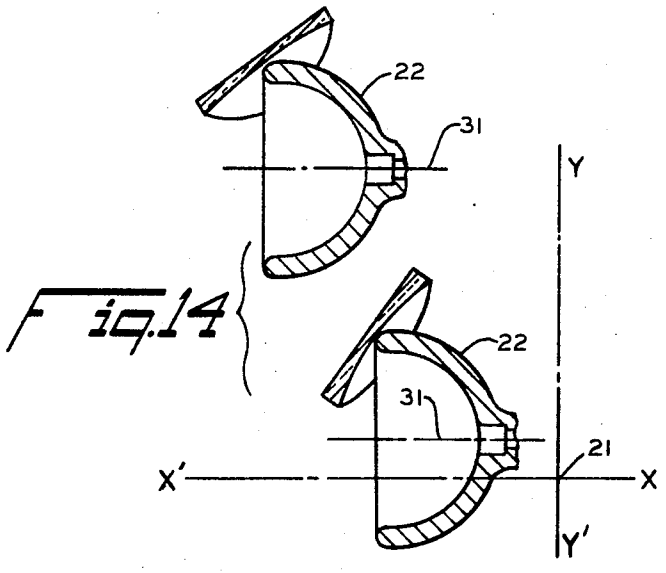


Fig. 14

TOOL POSITIONING MEANS FOR LENS GRINDER

BACKGROUND OF THE INVENTION

This invention relates to means for positioning a machine head which is carried on crossed slides and relates more particularly to machines for surface grinding toric lenses where the tool head is supported on a first slide which is, in turn, supported on a slide movable in a direction normal to that of the first slide.

Toric lens grinders, such as described in U.S. Pat. No. 2,589,488 to Fowler issued Mar. 18, 1952, have long been known and various charts and devices for determining the position of each of the crossed slides for each of the desired combinations of base curve and cylinder curve have been used with such lens grinders. Using such charts and position determining devices, each slide must be first positioned according to scales provided thereon and then the setting of at least one slide must be corrected according to the chart or position determining device. This requires laborious and time-consuming reference first to the slide scales and then to the chart or device for correction.

SUMMARY OF THE INVENTION

This invention contemplates the provision of an analogue computer carried by the head to be adjusted, the computer having an aiming device or target which can be positioned in the computer by setting a first indexed dial for the desired base curve and then setting a second indexed dial for the desired cylinder curve. A reference aiming point is provided on the base of the machine and a single control lever is provided for operating both slides in any desired direction for bringing the target and reference aiming point into alignment. Once alignment has been accomplished, the head is thereby positioned to obtain the desired base and cylinder curves without further correction of the position of the head.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a machine embodying tool positioning means according to the invention;

FIG. 2 is an enlarged perspective view of the reference aiming point device shown in FIG. 1;

FIG. 3 is a sectional view of the concave lens computer device on the line 3—3 of FIG. 1, certain parts being omitted or shown in broken lines for clarity;

FIG. 4 is a side elevational view of the computer device of FIG. 1, certain parts being omitted or broken away for clarity and certain parts being shown diagrammatically;

FIG. 5 is a front elevational view of the computer device;

FIG. 6 is a fragmentary, diagrammatic, rear elevational view of a portion of the computer device as viewed from the right in FIG. 3;

FIGS. 7, 8 and 9 are diagrammatic views on a smaller scale of the respective line circuit connections between the dials and the aiming target of the computer device of FIG. 1;

FIG. 10 is a diagrammatic view similar to FIG. 3, on a smaller scale, of a computer device for convex lenses;

FIG. 11 is a diagrammatic view of the reference aiming point, target, and slide positioning lever of the machine of FIG. 1 showing the mode of operation;

FIG. 12 is a fragmentary, perspective view of the crossed slide portion of the machine of FIG. 1, portions being cut away to show the slide-operating hydraulic cylinders;

FIG. 13 is a diagrammatic view of a chart showing a plurality of positions for lens curve settings on which the computer device of FIG. 1 is operatively based;

FIG. 14 is a fragmentary, diagrammatic view showing the relation between grinding tool and lens blank at two different settings for grinding concave lenses;

FIG. 15 is a longitudinal cross sectional view of the cylinder operating valve of the machine of FIG. 1; and

FIG. 16, on sheet 4 of the drawings, is an enlarged diagrammatic view of the valve seat of the valve shown in FIG. 15, the valve member seat-engaging surface being shown in broken lines.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the toric lens grinding machine **10** has a base **11** on which a turntable **12** is rotatably mounted. The table **12** has ways **13** in which the lens head slide **14** is movably mounted and slide **14** has ways **15** on which a lens head **16** is adjustably mounted.

A lens blank **17** is shown removably mounted in a vacuum chuck **18** on head **16** as is usual in such machines. A thickness setting wheel **19** and a thickness indicator dial **20** are also provided on head **16**.

It will be understood by those familiar with the art that the lens blank **17** is first positioned by securing head **16** on the ways **15** in the desired position. Slide **14** is then backed off to starting position and turntable **12** is then operated to rotate about its axis **21** to swing the blank **17** past and in contact with the tool **22** to grind the blank. Slide **14** is then advanced and the blank is then again swung past the tool for another pass. A micro-switch **23** is provided to sense the completion of the cut when the desired lens thickness is reached. Means for regulating the thickness of each successive cut are also provided. Motors, not shown, for turning the table **12**, for pumping coolant to the tool, and for advancing slide **14** are provided and sensing means, not shown, are provided for reversing the turning of the table after each pass and return so that, after the initial positioning of head **16**, the grinding operation takes place automatically.

Spaced from the turntable **12**, the tool **22**, in the form of a cup-shaped, diamond impregnated grinding wheel, is rotatably mounted, in a spatter housing **25**, on a longitudinally movable slide **26** mounted on ways **27**. The ways **27** form part of a cross slide **28** which is movably mounted on ways **29** on base **11** for movement transverse the machine. The crossed slides **26** and **28**, therefor can be moved to position the tool **22** in a plurality of positions with respect to the axis **21** of the turntable.

A motor **30**, carried of slide **26**, drives a shaft, not shown, rotatable in the slide by means of a belt, not shown, and the shaft, in turn, rotates the tool **22** by means of another belt, not shown. The axis **31** of the tool **22** is always in the same plane as the axis **32** of the lens blank **17** coaxially mounted in chuck **18**.

Hydraulic means, seen in part at **33** and more fully hereinafter described, are provided for moving slides **26** and **28** and a control panel **35** is provided at the front side of machine **10**. A switch **36** on the panel is provided for turning on and off the pump providing fluid under pressure for the slide moving means and a "joy stick" type of lever **37** is provided for controlling the movement of slides **26** and **28** as hereinafter described. Switches **38** are also provided on the panel for controlling operation of motor **30** and the other motors.

Above the control panel **35**, a reference aiming point device **39** is secured on a suitable bracket to the side of base **11**, the device being adapted to cast a narrow beam of light upward as a reference aiming point. Device **39** is shown enlarged in FIG. **2** and comprises a tube a having a light source therein at its bottom and a pair of lenses thereabove, one of which is shown at b, for collimating the light into a beam of parallel rays, as is usual in such devices. The light projected by the device **39** is adapted to project a spot of light less than one-fourth inch in diameter.

A computer device **40**, hereinafter described, and a housing **41** therefor are provided, the housing being secured on longitudinal slide **26** by the housing portion **42**. The computer **40** is adapted to slide into housing **41** and to be removable like a drawer. The computer device **40** overhangs the side of machine **10** and its outer side or end has two adjusting dials **43** and **44**, rotatable with their respective shafts **43'** and **44'** (FIG. **3**).

The outer side of housing **41** is provided with a translucent and non-transparent screen **45**, and a mirror **45'** indicated in broken lines in FIG. **1**, is set in the housing at about 45° to the vertical, allowing the operator to view the lighted images projected up through the computer **40** and reflected by the mirror

45' on the screen, the images being viewed in a vertical plane and avoiding errors of parallax.

Referring now to FIG. 12, the hydraulic means 33 are shown to comprise the hydraulic cylinders 46, 47, 48 and 49, having combined inlet and exhaust passages 46', 47', 48' and 49' respectively. Cylinders 46 and 47 have their respective ends connected to the ways 27 and slide 26 so that cylinder 46 operates to move the slide in one direction and cylinder 47 moves the slide in the other direction. Similarly, cylinders 48 and 49 have their ends connected to the ways 29 and slide 28 for moving slide 28 in opposite directions. It will be understood that a pair of two way cylinders could be used instead of the four cylinders 46–49 but the unidirectional cylinders are preferred because of the length of extension obtained thereby.

Referring now to FIG. 15, a valve 50, operated by the lever 37, is shown in longitudinal section. Valve 50 comprises a cover 51, a valve-member-enclosing middle body 52 having a valve member chamber 53 therein, and base portion 54. Seals 55 and 56 are provided between cover 51 and middle body 52 and between the latter and base portion 54.

A passage 57 is provided in middle body 52 connected to a source of fluid under pressure, not shown, the passage 57 leading to the chamber 53. Base portion 54 has a central passage 58 axially therethrough at its center connected to a pressure fluid reservoir, not shown, at atmospheric pressure and leads to a central exhaust port 59 in the valve seat surface in the plane 16—16 of FIG. 15.

A circular valve member 60 is provided in chamber 53 having an annular seat-engaging surface 61 which normally overlies four inlet ports 62 *a*, *b*, *c* and d arranged equiangularly spaced around, and equidistantly spaced from, the exhaust port 59, the ports 62*a*–62*d* being in the four polar directions shown in FIG. 16 and only ports 62*a* and 62*b* being shown in FIG. 15.

The valve base portion 54 has four passages connected, respectively, as shown to the ports 62*a*, 62*b*, 62*c* and 62*d* connected, as indicated in FIGS. 15 and 16, by flexible tubing to the combined intake and exhaust passages of the cylinders 46, 47, 48 and 49. The valve member 60 has the central opening in its annular seat-engaging surface capped as shown to form a circular passage 63 for connecting one of the ports 62 to the exhaust port 59 when the member is moved in any polar direction while the opposite port 62 is uncovered, exposing it to fluid under pressure.

Lever 37 passes through a spherical swivel member 64 rotatably seated between cover 51 and body 52, permitting motion of the lever in any direction, and its lower end terminates in a ball 65 engageable in a cooperating socket in member 60. A coil spring 66 normally biases the lever 37 and its ball 65 upward out of engagement with valve member 60 and a seal 67 is provided between swivel member 64 and the lever 37. A deliberate act of pushing the lever downward is therefore necessary by the operator before operating valve 50.

Four plungers 68, biased by springs 69 retained in cups 70, bear against the valve member 60, each plunger acting in one of the four polar directions, to normally maintain valve member 60 in its neutral central position covering the ports 62*a*–62*d*. The periphery of the valve member, tapered as shown, translates some of the plunger pressure into a downward force assuring contact between the working face of the member 60 and the port face of the valve seat.

Referring now to FIG. 16, it will be seen that when the annular working face 61 of the valve member is moved in any one of the four polar directions one of the ports 62, for example toward 62*a*, then 62*a* will be connected by the circular passage 63 at the center of the valve member to the exhaust port 59 while the opposite port, 62*b* in the example, will be uncovered and exposed to the hydraulic fluid under pressure to the chamber 53. In the example given above, cylinder 47 will be extended and cylinder 46 will be collapsed, moving slide 26 in the direction it is shown extended in FIG. 12. Movement of valve member 60 in the opposite direction moves the slide in the opposite direction. Movement of the valve member in either of the other two polar directions results in movement of slide 28.

It will also be apparent that, when valve member 60 is moved in any diagonal direction, two adjacent ports 62 will be connected to the exhaust port 59 and the opposite two adjacent ports 62 will be uncovered and subjected to pressure to move slides 26 and 28, the tool 22 being carried in a diagonal direction.

Referring again to FIG. 1 and assuming that the near side of the rim of the cup wheel tool 22 is the working side, the tool is shown positioned to the left of the axis of swing 21 of the turntable. If the slide 26 is extended until toll 22 passes the axis 21 extended and the lens blank 17 is then swung past in contact with the tool a concave lens is ground. The base curve, in the common plane of axes 31 and 32, is determined by the distance of the tools grinding edge from the axis 21 where it intersects the common plane.

The cross curve or cylinder, the curve in the plane normal to the common plane, is determined by the curvature of the wheel 22 and the angle at which axis 32 of the lens makes with the wheel during grinding. This is illustrated in FIG. 14 which shows the tool 22 as viewed from the back of the machine of FIG. 1. If the tool 22 is withdrawn to the other side of the Y–Y' axis of FIG. 14, a convex lens is generated, the cross curve being ground by the interior of the tool wheel rim. Axis 31 of the tool 22 is always parallel to the X–X' axis on the same side thereof. Curvature of the base and cylinder curves are conventionally measured in diopters, the reciprocal of the lens focal length expressed in meters.

Conventionally, prescriptions for changes in the curvatures vary by one-eighth diopter increments and over 1,400 combinations of base and cylinder curves are commonly prescribed. Over the years, however, charts for obtaining the most advantageous positions of the tool 22 for each combination of base and cylinder curves have been made. Such charts take the form of a succession of arcs 71 and straight lines 72, illustrated in FIG. 13, the diopter settings being at their intersections.

The straight lines are found to be tangent to a circle 73 centered at the axis 21 where it meets the common plane of axes 31 and 32 and whose radius may be computed from the diameter of the wheel tool 22 and the radius of curvature of its rim or lip. The arcs are found to be centered not at the center 21 by rather at the points of tangency of the lines 72 with the circle 73. If the lines 72 and arcs 71 are drawn at 10 diopter intervals, for example, intersections at one-eighth diopter intervals may be accurately found by interpolation.

Referring now to FIG. 3, the computer device 40 is shown as having a floor 75 and a front wall 76 in which the dial operated shafts 43' and 44' are rotatably mounted. A relatively small pulley 77 is fixed to the shaft 43' and a relatively large pulley 78 is fixed to the shank of pulley 77 so that both pulleys are operated by turning dial 43.

The dial shaft 44' is secured to a rotatable member 79 on which a first pulley 80 is rotatably mounted and a second pulley 81 is fixed. Pulley 80 carries a pin 82 projecting through an arcuate slot 83 in pulley 81 and a spring 84 continually biases pulley 80 with respect to pulley 81, as shown in FIG. 5, so that pulley 80 may act as take-up pulley for pulley 81.

Four pillars or posts 85, secured to the floor 75, support a cover 86 of a transparent material such as plastic, best shown in FIG. 4, the cover having side and back and walls extending down to the floor 75.

The floor 75 has a generally triangular portion 87, substantially a segment of a circle in outline, of glass or other transparent material, and supported on the portion 87, an aiming tube 88, best seen in FIG. 4, is movable in any direction by means now to be described. The tube 88 is vertically disposed and rests on radially projecting feet 89.

A segment of a pulley 90 is pivotally mounted on a post 91 secured to the floor 75. Post 91 also rotatably carries an upper pulley 92 and a lower pulley 93. Another pair of pulleys 94

and 95 tangent to pulleys 92 and 93 respectively, are carried on a second post 96 carried on pulley segment 90 inward from post 91, as best seen in FIG. 6.

Farther inward from post 91, along the curved edge 97 of the transparent portion 87 of the floor, an arcuate track 98 is secured to floor 75 and a carriage 99 is movable along the track. A pulley 100, mounted on a horizontally disposed axis substantially tangent to the arcuate side of floor portion 87, is mounted on carriage 99.

Referring now to FIG. 7, means for moving the carriage 99 comprises a non-stretchable cord 101, such as braided copper wire as used in a draftsman's board to operate a straight edge parallel to one edge of the board, secured at 102 to pulley 78. The cord 101 runs from the top of pulley 78 to a pulley 103 disposed at an angle, as shown in FIG. 3, around the pulley 103 and around the upper pulley 104 of a pair of pulleys 104, 105 at the back of device 40, as best seen in FIG. 6, and along an appropriate groove in track 98 to the carriage 99 to which it is secured. From carriage 99, the cord 101 extends along track 98 and around pulley 106 at the end of the track. From pulley 106 cord 101 extends over a conventional tensioning device 107 and then through a tube 108 and around the pulley 78 back to the point of fastening at 102.

The tensioning device 107 is shown in FIG. 3 as comprising a first pulley 107' rotatable on a post 109. A second pulley 110 is rotatably carried on an arm 111 which is also rotatable on post 109, the arm being passed by a spring, not shown, in the direction of the arrow 112. Cord 101, like the other cords hereinafter described, is shown in FIG. 3 in broken lines for clarity of illustration.

Referring now to FIG. 8, means for rotating the pulley segment 90 comprises another cord 115 secured at 116 to the smaller pulley 77, passing several turns around the pulley 77 and then around pulley 117 which is disposed at an angle like pulley 103 but spaced therefrom. From pulley 117, cord 115 extends under cord 101 to the pulley 105 below pulley 104 (FIG. 6), around pulley 105 to another pulley 118, rotatably secured to floor 75 adjacent the segment 90, around pulley 118 and around the pulley segment 90 to which it is secured at 119. The segment is biased in a counter-clockwise direction by a spring, diagrammatically shown as a leaf spring 120 in FIG. 8. Segment 90 is therefore turned clockwise by turning shaft 43' and turned counter-clockwise by spring 120 when shaft 43' is turned in the other direction.

It will now be apparent that turning dial 43 counter-clockwise moves the segment 90 and carriage 99 both in one direction and, when the dial 43 is turned in the other direction, segment and carriage move in the opposite direction. Pulleys 77 and 78, however, are of different diameters carefully chosen to give a straight line between carriage 99 and the tangent pulley 92 the desired tangent relation around the segment pivot 91.

Referring now to FIG. 9, means for moving the aiming tube 88 along the straight line determined by the position of segment 90 and carriage 99 comprises a third cord 121 having one end secured to the dial-44-operated pulley 81, wound partially around pulley 81, and then extending around an angularly disposed pulley 122 at the front corner of floor 75. From pulley 122 the cord extends to the upper pulley 123 of a pair of pulleys 123–124 at the back of floor 75, best seen in FIG. 4.

From pulley 123, cord 121 extends around pulley 94 on the segment 90, as shown in FIG. 3, thence back and partially around pulley 92, in the reverse direction, to the aiming tube 88 to which it is secured. From aiming tube 88, the cord extends over the pulley 100 on carriage 99 and then back through aiming tube 88, through which it now passes freely, to the pulley 93, below pulley 92, as best seen in FIG. 6, and around pulleys 93 and 95, in the path indicated in FIG. 3. From pulley 95, cord 121 then runs around pulley 124, under pulley 123, and around a horizontally disposed pulley 125, adjacent pulley 122, and thence around the pulley 80 where it is fastened, the spring 84 causing the last named pulley to act as a take-up pulley.

It will now be apparent that dial 44, when it is turned moves the aiming tube 88 back and forth, toward and away from the carriage 99. It will also be apparent, now, that dials 43 and 44 may have indicia marked thereon, as shown at 126 and 127 in FIG. 1, an index mark 128 and 129 being provided adjacent the respective dials. The indicia or scales 126 and 127 are appropriately marked in diopters and the base curve may first be set by the dial 44, the cylinder curve then being set by dial 43.

Referring again to FIG. 4, parts not shown in FIG. 3 include a bracket 130 secured on pulley segment 90 which supports a small mirror 131 at 45° to the vertical. The top of aiming tube 88 is beveled at 45° and a transparent mirror or light beam divider of glass 132 is secured to the top of the tube 88 for reflecting upward light from mirror 131. A collimated light source, not shown, projecting the image of a circle is secured in housing 41 above the computer device 40 and directs light down in the direction of arrow 133, in FIG. 3. The light reflected toward the glass 132 which reflects the light upward in the direction of arrow 134, to the 45° mirror in housing 41 and thence to screen 45. Since screen 45 is not transparent, an image is formed on the screen which can be superimposed on the circular image from light source 39, thus eliminating parallax errors caused by an observer not viewing the screen at precisely right angles to the screen.

It will now be apparent that the base and cylinder curves for the desired toric lens may be set by the dials 44 and 43 and aiming tube 88 is thereby positioned so that when slide 26 and device 40 are moved to a position with aiming tube 88 directly over the reference aiming point device 39, the tool 22 is positioned with respect to the swing axis 21 to grind the desired toric lens. Aiming tube 88 is approximately one-fourth inch in diameter, slightly larger than the collimated spot of light from source 39, so that very accurate positioning of slide 26 may be obtained.

The slide 26 is moved by the single lever 37 for moving tool 22 in any desired direction. When the operator views the screen 45, he views the light spot image from the beam of light from aiming point 39 in the mirror 45' and also views the annular light spot image projected by illuminated aiming tube 88 in the mirror. By moving lever 37, the operator can quickly align the projected images of reference point 39 and aiming tube 88. Two of the aiming tube legs 89 may be connected a cross the tube, thereby forming a cross-hair aiming spot with cord 121 passing through the tube which aiming spot is projected on screen 42 as a shadow.

With the particular connections shown in FIG. 16 between the slide cylinders and the ports 62 and lever 37 moves oppositely to the working surface of the valve member 61, so the operator moves the lever 37 in the direction he wishes to move the reference aiming point 39 with respect to the aiming tube 88, as indicated by the arrows 135 and 136 in FIG. 11.

When the images of reference point 39 and tube 88 are concentric, the tool 22 is positioned. The operator then adjusts the slide 14 for grinding the desired lens thickness, adjust the lens head 16 on ways 15 so that the lens blank 17 will contact the tool 22, swings the lens head 16 about axis 21 and adjusts the stops for automatically swinging the lens blank past the tool. The motors are then started by the buttons 38 an grinding takes place automatically.

It will be understood that the computer device 40 is for concave, or minus diopter, lenses only. When a convex lens is to be ground, however, the device 40 is removed from housing 41 and a convex, or plus diopter, computer device 40', as shown in FIG. 10, is substituted. The device 40' has the same parts as device 40 but they are arranged as a mirror image from side to side, as shown.

Since convex lenses are ground with the tool 22 to the left of axis 21, as shown in FIG. 1, another reference aiming point device, like that shown at 39, is provided located secured to the side base 11 below the housing 40 as shown in FIG. 1.

The machine is not necessarily limited to grinding opthalmic lenses. For lenses of higher power than are normally used for opthalmic purposes as, for example, instrument lenses,

another computer device, similar to the computers 40 and 40' but covering a different range of lens curves, may be substituted.

We claim:

1. In a machine having a head carried on a first slide, ways for the first slide carried transversely on a second slide, and ways on the second slide carried on the machine base, the machine having means for viewing the slides along the ways; head positioning means, comprising a housing secured on the first slide and having a transparent area overlying a portion of the base, means fixed to the base portion for projecting a beam of light upward through the transparent area, a vertically viewable target movable over the transparent area, means for moving the target to a preselected position in the transparent area, the selected position being computed for selected positioning of the head, whereby the target is first positioned and then the slides are moved to visually align the target with the light beam.

2. The machine defined in claim 1, the housing having means for illuminating the target, and a mirror fixed in the housing at an angle of 45° to the transparent area, one side of the housing including a translucent screen, whereby images reflected from the target and light beam are viewed on the screen for aligning target and beam.

3. In a machine having a work head and a tool head, one head being carried on a first slide movable on first ways extending in a first direction, the first ways being fixed to a slide movable on second ways extending in a direction normal to the first direction, the second ways being mounted on a fixed base, the machine having means for moving said slides along said first and second ways, the required adjustments of said one head on said slides being charted as a plurality of intersections of straight lines and arcuate curves; computer means, comprising: a box-like housing secured to the first slide and having a transparent area overlying a portion of the base, means fixed to said base portion for projecting a beam of light vertically upward through the transparent area, an aiming tube in the housing extending vertically upward and movable over the transparent area, first indexed dial means operatively connected for adapting the tube to be moved along any straight line extending as charted, second indexed dial means operatively connected to the tube for moving the tube to a point along any of the arcuate curves as charted, the dials being indexed for measuring the movement of the tube to positions on said straight lines and curves; whereby the aiming tube is first positioned by the indexed dial means to a selected position and then the one head is positioned with respect to the other head by visually aligning the aiming tube with the upwardly projected beam of light by moving said one head along said ways.

4. The machine defined in claim 3, including means for illuminating the aiming tube, and a mirror fixed in the housing at an angle of approximately 45° to the transparent area, the housing having a translucent viewing screen in one side opposite the mirror, whereby images reflected from the aiming tube and projected beam of light are viewed on the screen from the side of the machine without errors of parallax.

5. In the lens grinding machine having a base, a cup-shaped grinding wheel mounted on a tool slide movable longitudinally of the machine on first ways, the first ways being mounted on a cross slide movable transversely of the machine on second ways mounted on the base, the lens blank being mounted on a work slide movable toward and away from the wheel, the work slide being mounted on ways pivotally mounted in the machine for swinging movement of the blank past, and in contact with, the wheel; tool positioning means comprising means fixed to the base for directing a small beam of light vertically upward, framework fixed to the tool slide outlining a horizontally extending area having at least a portion transparent, a vertically extending aiming tube movable within the framework horizontally to selected positions in the transparent area, means for moving the tube over the transparent area, indexing means on the moving means calibrated for identifying preselected positions of the aiming tube, and means for adjusting the longitudinal and cross slides, whereby the aiming tube is positioned in a preselected position determined by the calibrations of the indexing means and the tool slides are then adjusted to bring the aiming tube into visual alignment with the upward beam of light, the lens is then advanced to contact the grinding wheel and is swung therepast for grinding a lens with base and cylinder curves determined by the calibrated position of the aligned aiming tube.

6. The machine defined in claim 5 having means for moving the tube over the transparent area comprising: a pulley segment pivotally secured in the framework adjacent the transparent section and carrying a first double pulley whose axis of rotation is spaced from the segment pivot, a second double pulley axially aligned with the segment pivot, an arcuate track secured in the framework adjacent the transparent section and opposite to the segment, a carrier movable along the track and carrying a third pulley, a first indexed dial secured to a shaft carrying a pair of dial pulleys, cord means connecting one of the pair of dial pulleys to the carrier for moving the carrier back and forth along the track, other cord means connecting the other of the pair of dial pulleys to the segment for turning the segment back and forth about its pivot, and a second indexed dial secured to a shaft carrying pulley means for moving the aiming tube along a straight line path between the second segment pulley and the third carrier pulley, still other cord means being connected to the second dial pulley means and running over said first and second and third pulleys and being attached to the tube, whereby the aiming tube is moved along a straight line path by turning the second dial and the angular direction of the line path is moved tangent to a circle determined by the size of the segment carried second pulley by turning the first dial.

7. The machine defined in claim 5 having means for adjusting the longitudinal and cross slides comprising: hydraulic cylinders having inlet and exhaust passages for moving each slide in opposite directions, a control valve having an annular valve member slideable in any direction on a flat valve seat, a control handle universally mounted in the control valve for moving the member in any direction, inlet and exhaust ports in the valve seat connected to the inlet and exhaust passages of the respective cylinders, and a central port in the valve seat connected to atmosphere, the inlet and exhaust ports being disposed equiangularly about the central port and so arranged that movement of the valve member in any one of four polar directions connects one port to a source of fluid under pressure for moving one slide in one direction while connecting the opposite direction exhaust port to the central port and movement of the valve member in a diagonal direction connects two inlet ports to a source of fluid under pressure while connecting the opposite direction exhaust ports to the central port for moving the grinding wheel in a diagonal direction.

8. The machine defined in claim 5 having means for adjusting the longitudinal and cross slides comprising: a first hydraulic cylinder for moving the tool slide longitudinally in one direction and a second hydraulic cylinder for moving the tool slide in the opposite direction, a third hydraulic cylinder for moving the cross slide in one transverse direction and a fourth hydraulic cylinder for moving the cross slide in the opposite transverse direction, the control valve having a central exhaust valve port and inlet ports equiangularly arranged around and uniformly spaced from the central port, each cylinder having a single combined inlet and exhaust passage connected to a respective inlet valve port of a central control valve, the control valve having an annular valve member normally covering all the inlet ports, the ports and valve member being so arranged that movement of the member in any one direction connects the inlet passage of one cylinder to a source of fluid under pressure and connects the inlet-outlet passage of the oppositely acting cylinder to the exhaust port and movement of the member in a diagonal direction connects the inlet passages of two cylinders to a source of fluid pressure for moving the wheel carrying slide in a diagonal direction

while connecting the inlet-outlet passages of the other two cylinders to the central exhaust port, and a universally mounted control lever for moving the valve member in any direction.

9. In a machine having a head mounted on a first slide, the slide being mounted on first ways for back and forth movement in one direction, the first ways being mounted for back and forth motion on a second slide mounted on second ways disposed in a direction normal to the first ways; means for moving the head in any direction, comprising: a first hydraulic cylinder mounted for moving the first slide in one direction, a second hydraulic cylinder mounted for moving the first slide in the opposite direction, a third hydraulic cylinder mounted for moving the second slide in one direction, a fourth hydraulic cylinder mounted for moving the second slide in a direction opposite to which it is moved by the third cylinder, a control valve having a flat seat enclosed in a sealed chamber supplied with fluid under pressure, the valve seat having an exhaust port centrally located in the chamber and connected to atmosphere, inlet ports in the valve seat equiangularly disposed around the exhaust port and equally spaced therefrom, each cylinder having a combined inlet and exhaust passage connected to a respective inlet port, a valve member in the valve chamber biased against the valve seat, the member being annular and having its central opening capped to form a separate passage always in communication with the exhaust port, and a control lever universally mounted in the control valve for moving the valve member in any direction, the valve chamber, member and ports being so arranged that movement of the control lever in one polar direction moves the member to expose the inlet port of one cylinder to fluid under pressure while the inlet port of the oppositely directed cylinder is connected by the member separate passage to the exhaust port for moving the head along one of the ways and movement of the control lever in a diagonal direction moves the member to expose the inlet ports of two cylinders to fluid under pressure while the inlet ports of the oppositely directed cylinders are connected by the member separate passage to the exhaust port for moving the head in a diagonal direction along both ways.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,670,460 Dated June 20, 1972

Inventor(s) Oldfield et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 3, line 42, first word, instead of "in", should be -- of --.

Col. 3, line 71, last word, instead of "to", should be -- in --.

Col. 5, line 28, "passed by a spring" should read -- biased by a spring --.

Signed and sealed this 5th day of December 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents