LENS POLISHING MACHINE

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Field of Search ..................................... 51/119-121, 51/160-124 L

References Cited
UNITED STATES PATENTS
3,552,899 1/1971 Tagnon........................................ 51/160
3,665,651 5/1972 Wylde..................................... 51/160

ABSTRACT
A high speed lens grinding and polishing machine comprising a gimbal mounted polishing element mounted at its lower extreme in a spherical bearing permitting an upper lens clamping element to follow the contour of the lens during the polishing process. Eccentric movement of the polishing element is accomplished by the cooperative movement of a breakup and main drive means. In addition, the machine includes a labyrinth seal to prevent slurry compound from flowing into the gimbal and drive means during operation of the machine.

13 Claims, 6 Drawing Figures
LENS POLISHING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention
A high speed lens grinding and polishing machine including a gimbal mounted polishing element mounted within a spherical bearing to permit an upper lens clamping element to follow the contour of the lens during the polishing process.

2. Description of the Prior Art
Numerous devices have been developed for grinding and polishing lens blanks for producing a compound curvature surface. Generally the lens blanks are ground to a predetermined toric shape and then polished with a lap tool having a curvature corresponding with that to be imparted to the finished lens.

In surfacesing operations, alignment axes of the lens blank and lap tool is critical. To maintain proper alignment various complex and elaborate structures to support the lens blanks and lap tools have been developed. Unfortunately the complexity of such devices present poor lens quality when operating at relatively high speeds. Generally existing machines fall into one of two groups. The first group shows various spring biased operable support shafts in combination with various lens support working tools. These devices disclose grinding and polishing machines employing a biasing spring to urge the work piece and lens upward against the grinding/polishing tool itself. The second group shows a number of polishing machines including movable linkages or spring biasing means attached to the upper portions of the machines or mechanism which urge the cutting or grinding tool into operative engagement with the lens or mirror surface.

Since the time required to produce a polished surface is dependent upon the relative movement between the lens blank and lap tool existing devices designed for low speed operations are inadequate. Other factors affecting the effective operating speeds are the initial lens blank surface, the pressure applied between the lens blank and lap tool and the polishing medium.

Present devices and techniques have not been able to meet the increased requirements for more accurate and efficient production methods without sacrifice of lens quality. This is particularly true due to the problems of balance and variations in the interface between the lens blank and lap tool during high-speed operations.

SUMMARY OF THE INVENTION

This invention relates to a high-speed lens grinding and polishing machine. More specifically, this machine comprises a bench model cabinet housing a gimbal mounted polishing element supported within a bearing housing.

The gimbal mounted polishing element comprises a spindle operatively coupled to a first drive means including a main drive for rotational movement and a breakout drive of constantly changing the center point of rotation of the main drive. A lens blank holder is attached to the upper portion of the spindle to hold a lens blank in operative communication with a lap tool held in place by a tool holder. A second drive means is attached to the tool holder to provide lateral movement of the lap tool relative to the lens blank. The lower portion of the spindle comprises a spherical bearing housed within the bearing housing.

An air cylinder is coupled to the tool holder to maintain a constant pressure between the lap tool and lens blank during the polishing process.

The machine also includes a polishing slurry means to supply a polishing slurry for the lens blank surface during the polishing process. In addition, a sealing means is provided to isolate the slurry from the gimbal and drive assemblies.

In operation the spindle and lens blank are driven in eccentric movement through the gimbal assembly by the first drive means. As the lens blank moves relative to the lap tool, the distance between the bearing housing and lap tool changes due to the curvature of the lap and lens blank. Since the spindle includes the spherical bearing the effective length of spindle varies to compensate for the changing bearing housing to lap tool distance providing a smooth, constant pressure polishing interface between the lens blank and lap tool.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings which:

FIG. 1 shows a partial cross-sectional top view of the present invention.
FIG. 2 shows a cross-sectional side view of the present invention.
FIG. 3 shows a detailed cross-sectional side view of the drive means of the present invention.
FIG. 4 shows a detailed partial cross-sectional top view of the gimbal assembly of the present invention.
FIG. 5 shows a detailed cross-sectional side view of the sealing means of the present invention.
FIG. 6 shows a detailed view of an alternative seal means.

Similar reference characters refer to similar parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, this invention comprises a bench model high speed lens grinding and polishing machine generally indicated as 10. As seen in FIGS. 1 and 2, the machine 10 includes cabinet 12 comprising front and rear panels 14/16 respectively. side panels 18/20 and bottom panel 22. Pivotedly attached to the upper portion of rear panel 16 is cover assembly 24. Extending vertically upward between side panels 18/20 is divider panel 26 separating cabinet 12 into enlarged rear enclosure 28 and open forward housing 30. Sink 32 is attached to divider panel 26.

Extending inwardly into the upper portion of sink 32 is tool holder means generally indicated as 34. Tool holder means 34 includes pin holder 36 attached to pin holder support means 38 extending outward from divider panel 26. Pin 40 is fixedly held within pin holder 36 to engage lap tool 42. Extending rearwardly through divider panel 26 is interconnecting means 41 that attaches plates 43 to support means 38.
A lens polishing element, generally indicated as 44, extends upwardly from housing 30 through aperture 46 formed in neck portion 48 of sink 32 and into sink 32. The lower portion of polishing element 44 comprises gimbal assembly 50 and spindle 52. The upper portion of spindle 52 is attached to lens holder 54 including adjustment means 56 to hold lens 58 of various sizes within lens holder 54. The upper portion of spindle 52 extends through neck 60 as more fully described hereinafter. The lower portion of spindle 52 is in operative communication with first drive means 62 as more fully described hereinafter.

As best shown in FIG. 4, gimbal assembly 50 comprises gimbal block assembly 150 operatively connected to U-shaped gimbal bracket 152 by lateral gimbal shaft 154. Bracket 152 is affixed to divider panel 26 by fastening means 156 (FIG. 1). Lateral gimbal shaft 154 is attached to bracket 152 at one end by set screw collar 158 and spacer 160, and at the opposite end by trust bearing 162, spacer 164 and fastening means 166. Trust bearing 162 is enclosed within felt washer 168. A longitudinal gimbal shaft 170 extends through gimbal block assembly 150 substantially at right angles to lateral gimbal shaft 154. Longitudinal gimbal shaft 170 is attached to block assembly 150 by fastening means 172, washer 173 and spacer 174 at one end; and washer 176, spacer 178 and set screw collar 180 at the opposite end.

First drive means 62, as best shown in FIG. 3, includes main drive housing assembly means 64 comprising main drive orbit sleeve assembly 66 and breakup sleeve assembly 68. The lower portion of spindle 52 extends through aperture 67 and terminates in spherical bearing 70 housed within bearing means 72. Bearing means 72 is secured within bearing housing 74 attached to the lower portion of sleeve assembly 66. Thrust race 76 is operatively disposed between annular bases 78 and 80 of sleeve assemblies 66 and 68 respectively.

Thrust bearing 82 is operatively disposed between sleeve assembly 68 and bearing plate 84 which is attached to sleeve assembly 66 by cap screws 86. The entire main drive housing assembly 64 is affixed to divider panel 26 by bracket means 88. An O-ring 90 and ring of bearings 92 are operatively disposed between base 80 and bracket 88. Bases 78 and 80 include annular grooves 94 and 96 respectively. As best shown in FIG. 1 and 3, sleeve assemblies 66 and 68 are interconnected to drive motors 98 and 100 respectively by V-belts 102 and 104 which are operatively coupled to grooves 94 and 96 respectively. Of course a single drive motor may be used in place of drive motors 98 and 100.

Drive motor 98 is mounted to housing 20 a mounting means comprising spring bias means 106 and 108. Spring bias means 106 comprises flexible linkage 103 affixed to the motor 98 and spring 105 affixed to the frame. Spring bias means 108 comprises rigid member 107 affixed to motor 98 and pivotally attached to the frame at 109, and spring 111 affixed to the frame. Idler wheel 113 is attached to member 107 by member 115.

Since main drive assembly 66 moves eccentrically relative to gimbal assembly 50 it is necessary that motor 98 coupled to main drive assembly 66 by V-belts 102 follow the changing between center point of the drive assembly 66. When drive assembly 66 of unit A is at its rearward most point of travel spring 111 will bias motor 98 rearward toward panel 16. As drive assembly 66 of unit A moves forward away from panel 16 V-belt 102 draws motor 98 forward. Simultaneously the distance between drive assembly 66 and motor 98 decreases V-belt 102 of unit B rides against idler wheel 113 to take up the slack. As drive assembly 66 of unit A returns to the rearward most position spring 111 draws motor 98 rearward to maintain the tension of V-belt 102 of unit A. This action continues throughout the operation of the device 10.

As seen in FIG. 1, second drive means generally indicates as 110 provides lateral movement of tool holder 34 relative to lens holder 44. Second drive means comprises linkages 112 fixedly attached to plates 43 and eccentric drive post 114. The lower portion of eccentric drive post 114 is operatively coupled to drive motor 100 by V-belt 116. Eccentric drive post 114 is disposed within bearing 118.

As shown in FIG. 1 the machine also includes polish slurry means to supply a polishing fluid. The polish slurry means comprises a manifold means 120 intersecting a slurry pump means (not shown) and feed tubing 122. Feed tubing 122 is coupled to nozzle means 124 held in operative communications with tool holder means 34 and lens blank 58 by support means 126 attached to divider panel 26. Return drain 128 is formed in the bottom of sink 32 whereby the slurry is recirculated to the pump for continuous use.

As shown in FIG. 2, the machine includes a constant pressure means to maintain the pressure between the lap tool 42 and lens blank 58 at an adjustable predetermined pressure during the polishing process. The constant pressure means comprises an air cylinder 126 pivotally connected at one end to plate 43 and at the opposite end to divider panel 26. The air cylinder 126 is operatively connected to a pneumatic panel assembly 128 within housing 28.

As shown in FIG. 5, the machine further includes a sealing means generally indicated as 130 comprising baffle 132 and cup-shaped labyrinth 134. Baffle 132 comprises an annular seal 136 including groove 136 affixed to neck 60. Labyrinth 134 comprises a cup-shaped outer member 138 affixed to the upper end of spindle 52. Affixed to inside of outer member 138 is a second cup-shaped inner member 140 including a central aperture 142 in sealing engagement with the inner portion of groove 136.

FIG. 6 shows an alternate seal means 135 comprising elliptically shaped enclosure 137 including sleeve 139 and aperture 141. Sleeve 139 is affixed to neck 60 by coupling means 143. The upper end of spindle 52 is attached to tool holder 54 through aperture 141.

A shown in FIG. 2, the machine includes leveling means 144 rotatably attached at each end of button panel 22 and automatic timer 146 to turn off first and second drive means 62 and 110 respectively and pressure means after a predetermined time laps.

In operation, lens blank 52 is placed within the adjustable lens holder 54 and affixed thereto. Lap tool 42 is then operatively engaged therewith and held in operative position by pin 40 of tool holder 34. The pressure between these surfaces is applied by adjusting the pressure of air cylinder 126. The machine 10 may be used for either grinding or polishing. According to whether it is a rough or smooth finish, the pressure is adjusted and the timer 146 is set to automatically run for a predetermined time. Once actuated motors 98 and 100 drive spindle 52 in eccentric movement relative to pin 40 and lap tool 42 through gimbal assembly.
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44. This eccentric movement results from the circular movement of the main drive assembly 66 and breakup drive assembly 68 constantly moving the center point of the circular movement. It should be noted in FIG. 1, two polishing assemblies may be placed in tandem and driven simultaneously by motors 98 and 100.

Where desired, slurry polish may be applied against the lens blank surface to assist in the polishing process. This is accomplished by pumping the polish slurry through manifold 120, tubing 122 and nozzle 124 onto the lens blank 42 itself. As the slurry is thrown from the moving surfaces it is returned to the slurry pump (not shown) through drain 125. It should be particularly noted that sealing means 16 prevents the slurry polish from flowing through neck 62 and onto the gimbal assembly 44 and drive means 62.

It should also be noted that the tool holder 34 and lap tool 42 may be moved laterally relative to the lens blank 52 and lens holder 54 by second drive means 110.

During the polishing process as the lens blank 52 moves in relation to lap tool 42, the distance between bearing housing 72 and lap tool 42 changes due to the curvature of lap tool 42 and lens blank 42; eccentric movement of lens blank 42 and lateral movement of lap tool 42. Since spindle 52 includes bearing 70, spindle 52 rises within housing 72 to effectively change virtual length of spindle 52 to compensate for the changing housing 72 to lap tool 42 distance providing a smooth, constant pressure polishing interface lens blank 52 and lap tool 42.

It will thus be seen that the object made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention, which as a matter of language, might be said to fall therebetween.

Now that the invention has been described.

What is claimed is:

1. A high-speed lens polishing machine comprising a cabinet and a polishing element mounted thereon, said polishing element including spindle means and lens holding means configured to retain a lens blank, first drive means attached to said cabinet operatively coupled to said polishing element, tool holding means attached to said cabinet, said tool holding means configured to retain a lap tool, said tool holding means in operative communication with said lens holding means, said first drive means moving said lens holding means relative to said tool holding means, said spindle means including a substantially circular bearing means and said first drive means including a substantially spherical bearing means, said substantially circular bearing means being movably disposed within said substantially spherical bearing means such that said spindle means moves within said drive means to change the virtual length of said spindle means relative to said tool holding means whereby tool holding means follows the contour of lens during the polishing process.

2. The high-speed lens polishing machine of claim 1 further including a second drive means operatively connected to said tool holding means to move said tool holding means laterally relative to said lens holding means during the polishing process.

3. A high-speed lens polishing machine of claim 1 further including a gimbal assembly means interconnected to said cabinet said spindle means being operatively coupled to said gimbal assembly means and wherein said drive means comprises a main drive assembly means and breakup drive assembly said lens holder in a substantially circular orbit and said breakup drive assembly means constantly changing the center point of the circular orbit relative to said lap tool holder whereby said lens holding means follows an eccentric orbit relative to said tool holding means during the polishing process.

4. The high-speed lens polishing machine of claim 3 further including a slurry polish supply means comprising manifold means, tube means and nozzle means, said nozzle means in operative communication with said tool holding means and said lens holding means to provide slurry polish during the polishing operation.

5. The high-speed lens polishing machine of claim 4 further including a seal means isolating said lens holding means, said tool holding means and said slurry polish supply means from said gimbal assembly means and said first drive means.

6. The high-speed lens polishing machine of claim 5 wherein said seal means comprises a cup-shaped labyrinth including outer cup-shaped member affixed to said spindle and inner cup-shaped member affixed to said outer cup-shaped member.

7. The high-speed lens polishing machine of claim 6 wherein said seal means further includes a baffle engaging said inner cup-shaped member to seal said spindle means, said gimbal means and first drive means from said slurry polish.

8. The high-speed lens polishing machine of claim 7 wherein said baffle comprises a resilient substantially annular member including a groove formed about the circumference thereof and said inner cup-shaped member includes a substantially annular aperture from therein such that the inner periphery of said annular aperture sealingly engages the inner periphery of said groove to cooperatively form a seal therebetween.

9. The high-speed lens polishing machine of claim 1 further including a fluid pressure means attached to said tool holding means to maintain a substantially constant predetermined pressure between said lens blank and said lap tool during the polishing process.

10. The high-speed lens polishing machine of claim 9 wherein said seal means comprises an enclosure including a sleeve portion affixed to said spindle.

11. The high-speed lens polishing machine of claim 10 further including motor means operatively interconnected to said main drive assembly means to drive said main drive assembly means.

12. The high-speed lens polishing machine of claim 11 wherein said motor means coupled by flexible belt means to said main drive assembly means.

13. The high-speed lens polishing machine of claim 12 wherein said motor means is attached to said machine by mounting means, said mounting means comprising biasing means such that said mounting means follows the movement of said spindle assembly during the polishing process.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,838,542 Dated October 1, 1974

Inventor(s) Lee R. Hodges

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

Column 6, line 62, delete "mah-".

Column 6, line 63, delete "cine" and insert therefor -- machine --.

Signed and sealed this 22nd day of April 1975.

(SEAL)

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks