

No. 739,264.

PATENTED SEPT. 15, 1903.

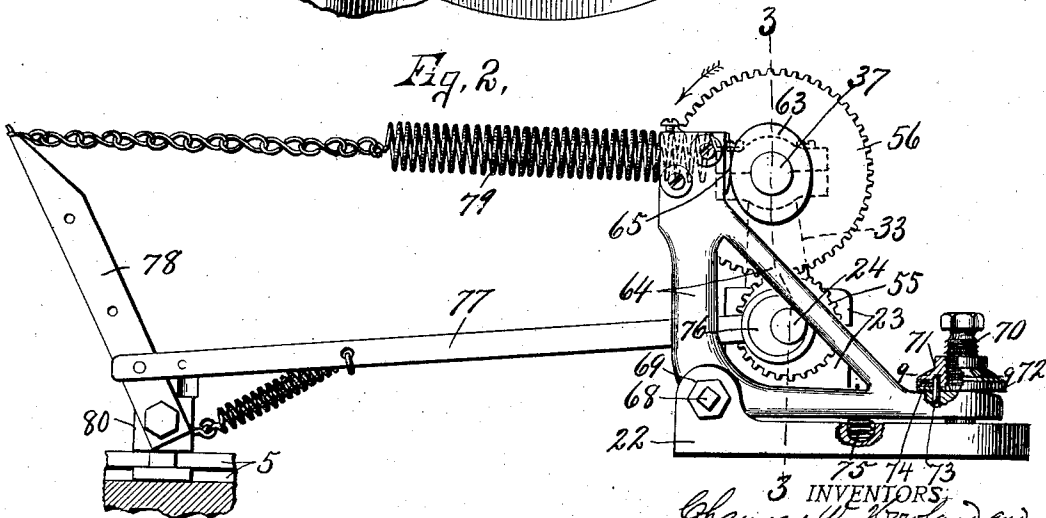
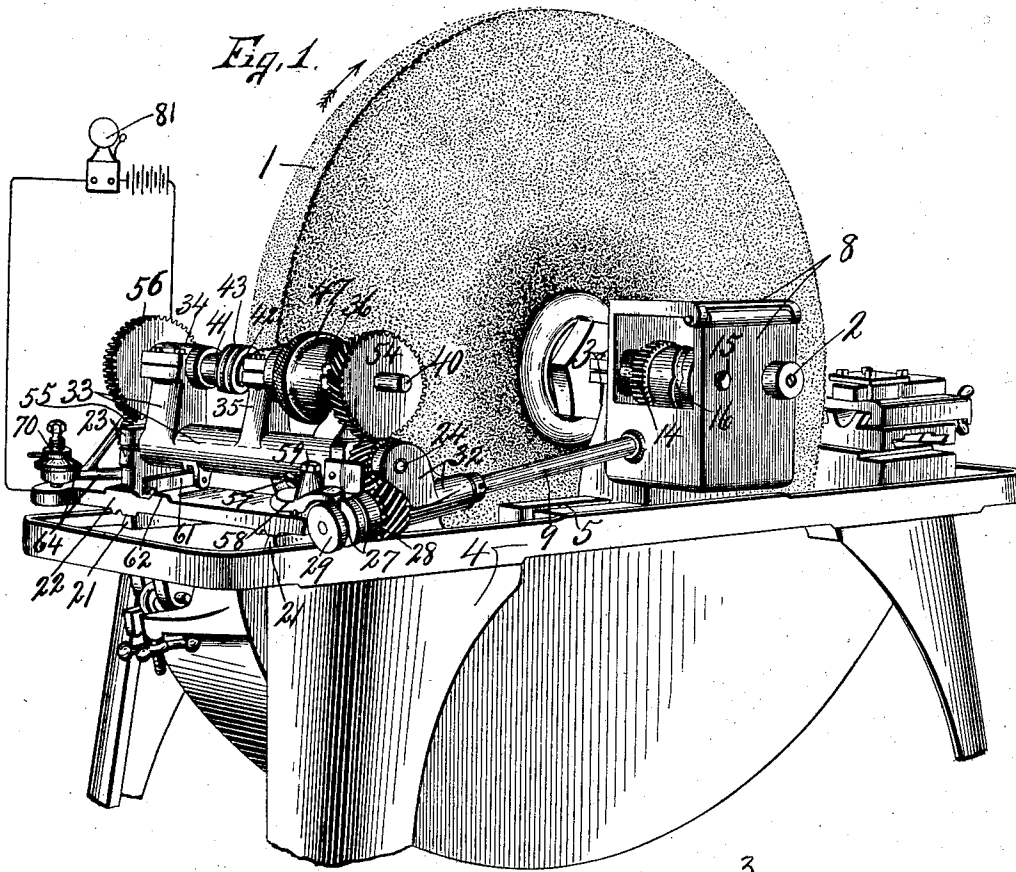
E. M. LONG & C. W. HOWLAND.

LENS GRINDING MACHINE.

APPLICATION FILED NOV. 19, 1902.

NO MODEL.

3 SHEETS—SHEET 1



WITNESSES:

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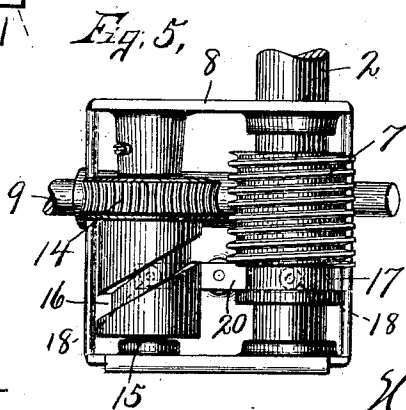
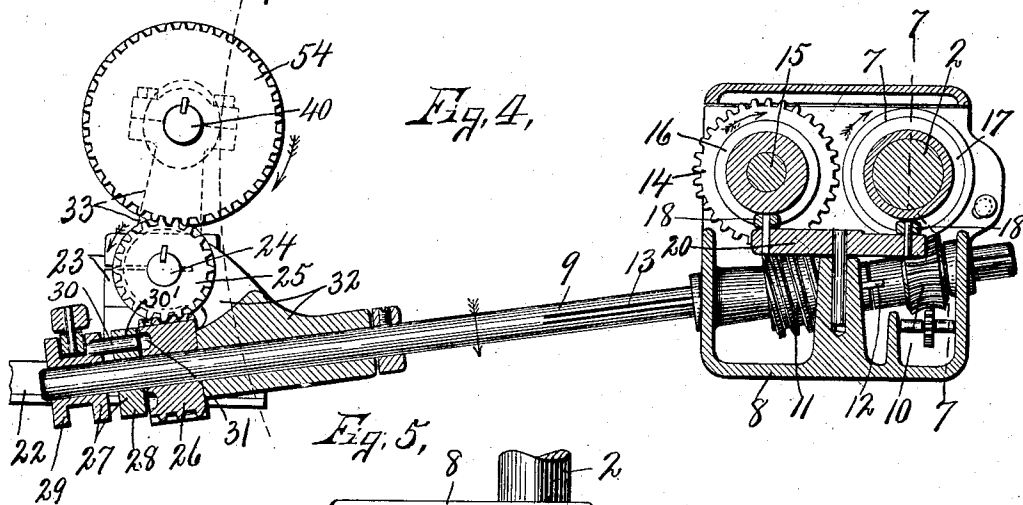
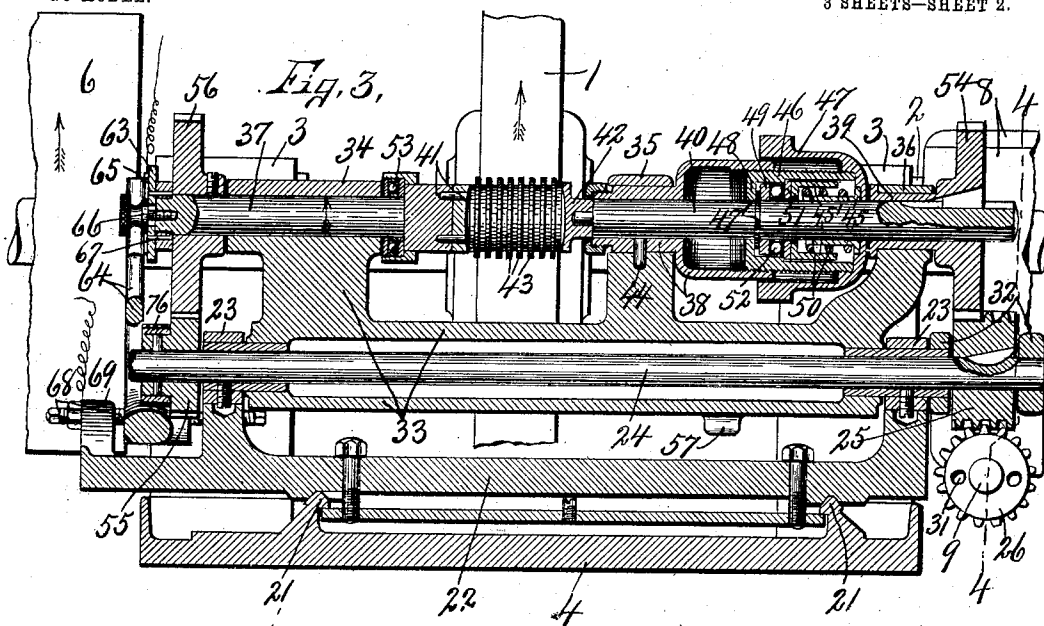
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3 SHEETS—SHEET 2.



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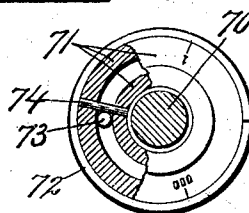
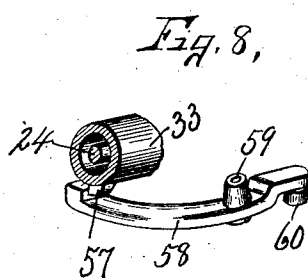
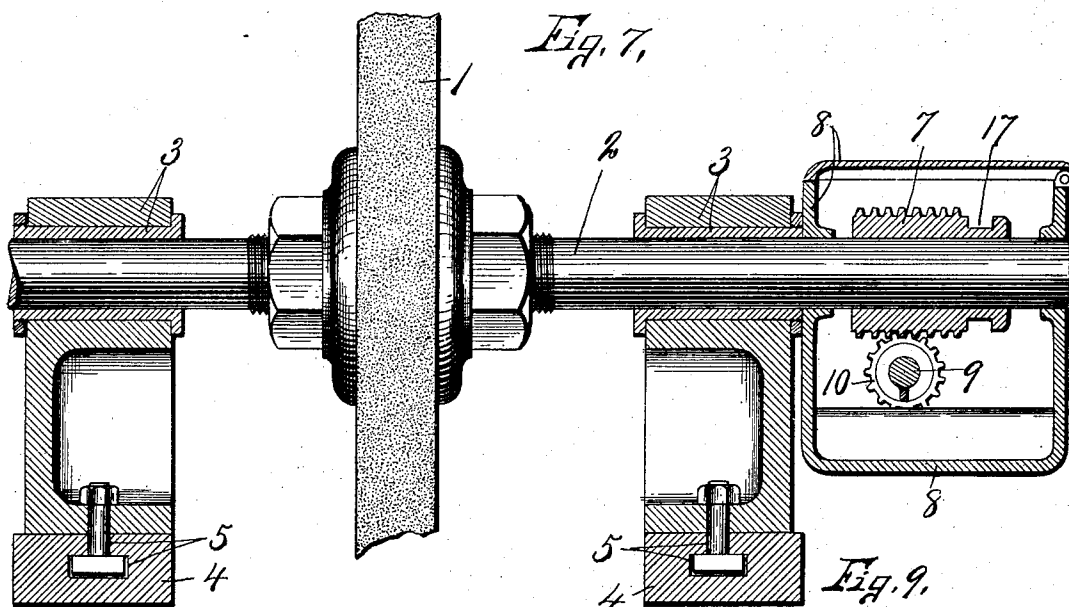
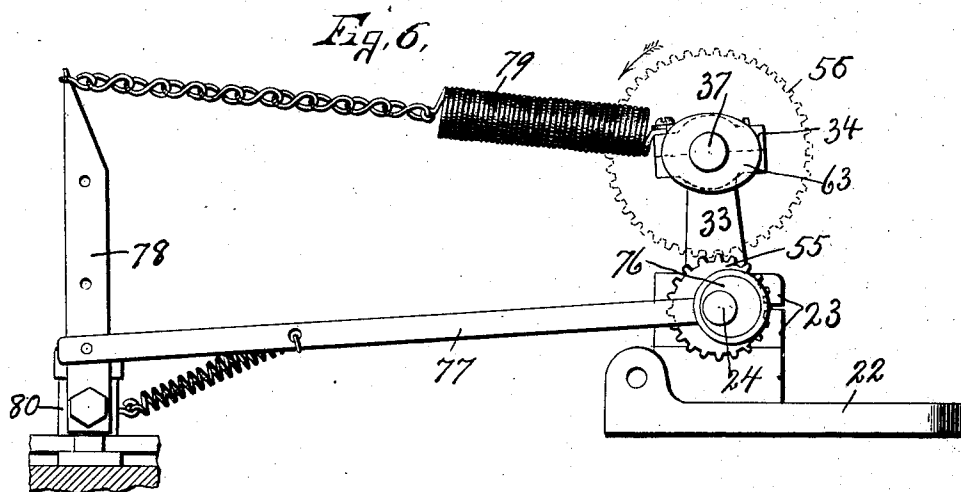
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3 SHEETS—SHEET 3.



WITNESSES:

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UNITED STATES PATENT OFFICE.

ELI M. LONG AND CHAUNCEY W. HOWLAND, OF GENEVA, NEW YORK.

LENS-GRINDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 739,264, dated September 15, 1903.

Application filed November 19, 1902. Serial No. 131,913. (No model.)

To all whom it may concern:

Be it known that we, ELI M. LONG and CHAUNCEY W. HOWLAND, both of Geneva, in the county of Ontario, in the State of New York, have invented new and useful Improvements in Lens-Grinding Machines, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

10 This invention relates to improvements in machines for grinding lenses, the primary object of which is to grind the edges of all classes of lenses with uniformity, accuracy, and speed.

15 Several distinct mechanisms are employed in different parts of the combined machine, and although superficially appearing to be remote from each other they all contribute to carry out this one object.

20 Certain forms of lenses, such as the plano-circular and spherocircular type, in which the edge is of substantially uniform thickness throughout, may be easily and quite accurately ground on ordinary machines, but

25 in grinding the edges of elliptical lenses of any facial contour it has been discovered that as the point of contact with the grindstone shifts from the short to the long axis the pressure of the lens upon the stone is

30 greater than when said contact-point is shifting from the long to the short axis, and therefore the portion of the perimter of the lens under greatest pressure is more rapidly ground away than the remaining portions.

35 Furthermore, as the edges of a large majority of such elliptical lenses are thinner on the major axis than on the minor axis the difference of time in grinding is greatly increased. This inequality of pressure and abrasion is

40 due to the fact that it is necessary to provide some force for automatically holding the edge of the rotating lens against the stone and that as the length of radius to the point of contact is continually changing the position

45 of the axis of rotation of the lens gradually moves toward and from the stone, and when the point of contact is shifting from the short to the long axis the force which holds the lens to the stone is counteracted and the resistance borne entirely by this portion of the

lens, whereas when the point of contact shifts from the long to the short axis the axis of rotation moves reluctantly with said force and the abrasion of this portion of the lens is comparatively light.

55 Cylindrical lenses in a majority of cases are provided with their major axes corresponding with their optical axes if concave and with the optical axes at right angles with their major axes if convex, so that the same effect is produced as previously described. Our purpose, therefore, is to provide means to compensate for this inequality on the grinding effect upon the lenses by forcing certain portions of the lens against the stone with

60 greater pressure than other portions.

Another object is to move the grindstone axially or across the edge of the rotating lens instead of moving the lens across the face of the stone, because it has been found to be

70 more practicable and grinds the lens with a steadier action, since all the necessary movements are not then concentrated in the lens-support, the special purpose being to provide a constant and uniform speed in the reciprocal

75 movement of the stone.

A still further object is to provide a suitable annunciator to enable the attendant to ascertain without inspection when the lens is sufficiently ground or sized, thereby saving

80 time and obviating the necessity for carefully watching the grinding process.

In the drawings, Figure 1 is a perspective view of a lens-grinding machine embodying the various features of our invention. Fig. 85 2 is an end view of the lens-holding frame and the mechanism for equalizing the pressure of the lens against the stone. Figs. 3 and 4 are sectional views taken, respectively, on lines 3 3, Fig. 2, and 4 4, Fig. 3, showing in connection with Fig. 4 the grindstone-shaft and the means for moving said shaft axially. Fig. 5 is a top plan of the mechanism for moving the grindstone axially and for transmitting motion from the grindstone-shaft to the intermediary shaft which drives the lens-holding

90 devices. Fig. 6 is a view similar to Fig. 2, showing the detached pressure-equalizing device in a different position. Fig. 7 is a sectional view on line 7 7, Fig. 4. Fig. 8 is a per-

95 100

spective view of the lower end of the oscillating frame and oscillating pawl. Fig. 9 is a sectional view on line 9 9, Fig. 2.

Similar reference characters indicate corresponding parts in all the views.

In carrying out the objects of this invention a grindstone 1 is fixed to the intermediate portion of a rotary shaft 2, which in turn is journaled in suitable bearings 3 and is also movable axially in said bearings to move the stone across the edges of the lenses. These bearings are preferably mounted upon a main supporting-frame 4 at opposite sides of the stone and are movable on ways 5 toward and from the lens-support to compensate for varying distances of the face of the stone from the lens-holder presently described. Rotary motion is imparted to the shaft 2 and stone 1 from any desired source of power, which is connected to the fixed pulley 6 on the outer end of the shaft 2 at the left of the stone, as seen in Fig. 3. The opposite or right-hand end of the shaft 2 extends beyond the adjacent bearing 3, is provided with a worm 7, and also carries a shell or housing 8, which is pivotally hung upon the shaft 2 and incloses the worm 7 and suitable mechanism for transmitting axial or reciprocal motion from the worm 7 to the shaft 2 and grindstone 1 and also forms a convenient bearing for one end of an intermediary driving-shaft 9. This shaft 9 is journaled in the front and rear walls of the housing 8 at substantially right angles to the shaft 2 and is provided with a gear 10, which meshes with the worm 7 and by which the shaft 9 is rotated, the worm 7 being secured to the shaft 2 to move axially therewith. A second worm 11 is mounted on the shaft 9 at one end of the gear 10 and is locked to said gear by a key 12, which is also seated in a keyway 13 in the shaft 9 and locks both the gear 10 and worm 11 to rotate with the shaft 9 and at the same time permits said parts to move axially with reference to each other. The worm 11 meshes with and rotates a second gear 14, which is mounted upon a spindle 15 within the housing 8 and substantially parallel with the shaft 2, the gear 14 being provided with a hub having a diagonal groove or cam 16 in its periphery, and the worm 7 is also formed with an annular groove 17, said grooves receiving rollers 18, which are mounted upon the opposite ends of an oscillating lever 20, whereby axial and reciprocal movement is imparted to the worm 7 and shaft 2 to move the stone across the edges of the lenses.

It has thus far been shown that the power derived from the rotation of the grindstone-shaft is utilized to shift it axially, and it will be apparent from the following description that this same power is also applied to rotate the lens-clamps through the medium of the shaft 9.

Mounted upon suitable ways 21, which form a part of the main frame 4 and are parallel

with the ways 5, is a sliding support 22, having upwardly-projecting bearings 23, and journaled in these bearings is a shaft 24, to which rotary motion is transmitted from the shaft 9 through the medium of gears 25 and 26 and a clutch 27, the gear 25 being secured to the adjacent end of the shaft 24, and the gear 26 is loosely mounted on the shaft 9. The clutch 27 is also mounted on the shaft 9 and comprises a fixed collar 28 and a sliding grooved collar 29, the latter collar having a stud 30, which slides in an aperture 30' in the former collar and is movable into and out of recesses 31 in the adjacent end face of the gear 26, whereby the shaft 9 may continue to rotate with or without the gear 26. This end of the shaft 9 is journaled in a swinging bracket 32, which is loosely mounted upon the outer adjacent end of the shaft 24, so that the support 22 or grindstone 1 may be readily adjusted toward and from each other without cramping the shaft 9 in its bearings.

An oscillatory frame 33 is loosely mounted upon inwardly-projecting ends of the bearings 23 to oscillate concentrically with the shaft 24, and this frame is also provided with upwardly-projecting bearings 34, 35, and 36, the bearing 34 receiving and supporting a revoluble spindle 37, and the bearings 35 and 36 receive and support suitable sleeves 38 and 39, which in turn receive and support a second revoluble spindle 40, having its axis coincident with the spindle 37.

The spindles 37 and 40 are parallel with the shaft 24 and are rotated simultaneously at the same rate of speed, the inner or adjacent ends being provided with lens-clamping heads 41 and 42, between which one or a plurality of lenses 43 may be firmly held and rotated against the grindstone, it being understood that the spindles 37 and 40 are substantially parallel with the axis of revolution and face of the grindstone. One of the spindles, as 37, is fixed from endwise movement, while the opposite spindle, carrying the head 42, is movable axially to permit the insertion or removal of the lenses and to hold them firmly in place during the operation of grinding. In order to effect this axial movement of the spindle 40, the sleeve 38 is fixed from rotary or axial movement in the bearing 35 by a pin 44, and its outer end is enlarged and threaded interiorly and receives an exteriorly-threaded rotary coupling 46, which in turn is secured at its outer end to a rotary hand-drum 47, telescoping with the outer end of the sleeve 38 and rotatable independently of the spindle 40.

A sleeve 45 encircles the spindle 40, one end being flanged outwardly, and is seated loosely against the end wall of the handpiece 47, while a second loose sleeve 45' encircles the sleeve 45, and its inner end is flanged inwardly, a spring 50 being interposed between the sleeves with its opposite ends abutting against their end flanges. A fixed shoulder

47' on the spindle 40 is interposed between a flange 48 on the coupling 46 and a hardened ring 49, which is tightly fitted to the spindle, and between this ring 49 and a similar loose hardened ring 51 is an end-thrust ball-bearing 52, the spring 50 acting to hold the inner end of the sleeve against the ring 51, and thus holds the spindle axially under yielding pressure, and the ball-bearing 52 serving to reduce the friction, a similar end-thrust bearing 53 being interposed between the head 41 and its bearing 34 for the same purpose. Rotary motion is imparted to the spindle 40 through the medium of the gear 25 and an intermeshing gear 54, which is feathered upon said spindle to rotate the same and at the same time permit the spindle to be moved axially.

The opposite spindle 37 is rotated in the same direction as the spindle 40 by means of intermeshing gears 55 and 56, which are secured, respectively, to the shaft 24 and spindle 37, and it is now apparent that although the grindstone may rotate continuously the rotation of the lens-holders may be stopped and started at the will of the operator by means of the clutch 27 and that the clamping-head 42 may be moved axially by simply rotating the drum 47.

The rotation of the lens-holders is preferably stopped automatically when the oscillating frame 33 is rocked backwardly in the act of withdrawing the lenses from contact with the stone and particularly when the grinding operation is completed, and for this purpose the frame is provided with a lug 57, depending beneath its axis and arranged to engage one end of a lever 58, which is fulcrumed at 59, and its other end is provided with a roller 60, riding in the annular groove of the collar 29, as best seen in Figs. 1, 4, and 8, a suitable catch 61 being connected to the oscillating frame for engaging a lug 62 on the sliding bed and holding said oscillating frame in its inoperative position.

The means for sizing and forming the lenses consists of a former 63 and a bell-crank lever 64, carrying a contact-piece 65, the former 63 being of the same outline as desired for the lens to be ground and is removably secured to the outer end of the spindle 37 by a suitable clamping-screw 66 and pins 67, and the lever 64 is fulcrumed in an upright position at 68 to bearings 69 on the sliding support 22 and is adapted to be rocked to change the position of the contact-piece 65 relative to the axis of the former for varying the size of the lens when desired.

The means for adjusting the lever 64 preferably consists of a threaded stud 70 and a graduated rotary nut or threaded disk 71, mounted on the threaded stud and having its graduations adapted to register with an indicator-disk 72, the stud 70 being secured to the support 22 and projecting upwardly through a slot in one arm of the lever 64, and the disk 72 rests upon and is locked to the upper face of said arm by a pin 73, which en-

ters an aperture in the lower wall of said disk and projects into the path of a transverse stop 74 in the nut 71 to limit the rotary movement of said nut. This nut 71 is mounted to rotate upon the disk 72 and stud 70 to rock the lever against the action of a spring 75 and to thereby adjust the position of the contact-piece 65.

In order to compensate for the inequality in pressure and consequent unequal abrasion or grinding of the lens during the process of grinding the same, an eccentric 76 is provided upon the shaft 24, which shaft is geared to rotate at twice the speed of the spindles 37 and 40, and this eccentric is connected by a pitman 77 to an upright lever 78 at a point above its fulcrum, the upper end of the lever being connected by a spring 79 to the oscillating frame 33 at a point above its axis. The eccentric is positioned with reference to the long and short axis of elliptical lenses, so that the tension of the spring is gradually increased from minimum to maximum while the contact-point of the lens with the stone is shifting from the long to the short axis, and this tension is gradually diminished while the point of contact is changing from the short to the long axis. It is therefore apparent that while the spring is being tensioned the lens is being pressed with greater force against the stone and grinds away the lens more rapidly to compensate for the natural reluctance of contact while passing from the long to the short axis, while, on the other hand, when the contact is shifting from the short to the long axis, during which the resistance due to the gravity of the oscillatory frame, which is usually augmented by a spring, is borne entirely by the lens, and during this time the eccentric causes a relaxation in the tension of the spring, and therefore tends to grind the lens under a more uniform pressure throughout its perimeter.

The upright lever 78 is usually fulcrumed on a support 80, which is adjustably secured in one of the ways 5, so that the parts of this compensating mechanism may be adjusted to a nicety, and although the utility of this mechanism has been specifically described for grinding elliptical lenses it will be obvious to any one skilled in the art that it is equally applicable for grinding cylindrical lenses, whether circular or elliptical, in which the edges to be ground are thinnest on the optical axis corresponding to the long axis of the plano or spherical elliptical lenses or on the axis at right angles with the optical axis.

The bearing-face of the contact-piece 65 is curved to conform as nearly as possible to the curvature of the stone, so that the contact of both former and lens is always practically in the same plane parallel with their axes, which produces a more perfectly-formed lens. This contact-plate is preferably formed of electric conducting material and insulated from the lever and, together with the former, is connected in circuit with an annunciator,

as a bell 81, the object of this being that as soon as the lens is ground to the desired size throughout its perimeter the circuit will be closed continuously through contact of the former with the plate 65, and the attendant is then informed of this fact through the continued action of the bell or other annunciator.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a lens-grinding machine, the combination with a grinder, of a rotary lens-holder, a spring connected to move the lens-holder toward the grinder, and automatic means to vary the tension of the spring to produce a uniform grinding effect upon the lens.

2. In a lens-grinding machine, the combination with a grinder, of a rotary lens-holder, a spring connected to move the lens-holder toward the grinder, and automatic means to increase the tension of the spring when the grinding effect on the lens tends to be reduced.

3. In a lens-grinding machine, the combination with a grinder, of a rotary lens-holder, a spring connected to move the lens-holder toward the grinder, and automatic means to reduce the tension of the spring when the grinding effect on the lens tends to increase.

4. In a lens-grinding machine, the combination with a grinder, of a rotary lens-holder having independent movement toward and from the grinder, a spring connected to move the holder toward the grinder, and automatic means separate from the holder to vary the tension of the spring.

5. In a lens-grinding machine, the combination with a grinder, of a rotary lens-holder having independent movement toward and from the grinder, a spring connected to move the holder toward the grinder, a movable member separate from the holder and connected to the spring, and automatic means to move said member.

6. A machine for grinding elliptical lenses comprising a grinding-surface and a rotary lens-holder, one of the parts being movable automatically toward the other to bring the edge of the lens and said surface into contact, and automatic means to increase the pressure of said contact as it shifts from the long to the short axis.

7. A machine for grinding oval lenses comprising a grinding-surface, a rotary lens-holder movable automatically toward said surface to contact the edge of the lens therewith, and automatic means acting on the lens-holder to increase the pressure of said contact as it shifts from the long to the short axis.

8. A machine for grinding oval lenses comprising a grinding-surface, a rotary lens-holder movable automatically toward said surface to contact the edge of the lens therewith, and automatic means acting on the lens-holder to increase the pressure of said contact as it shifts from the long to the short

axis, said means acting to reduce the pressure of the contact as it shifts from the short to the long axis.

9. A machine for grinding oval lenses comprising a grinding-surface, a rotary lens-holder gravitating toward said surface to contact the edge of the lens therewith, a spring connected to force the holder toward the grinding-surface, and automatic means to gradually tension the spring as the contact is shifting from the long to the short axis.

10. A machine for grinding oval lenses comprising a grinding-surface, a rotary lens-holder gravitating toward said surface to contact the edge of the lens therewith, a spring connected to force the holder toward the grinding-surface and an eccentric connected and operating to tension the spring as the contact shifts from the long to the short axis.

11. A machine for grinding lenses, the combination with a grinding-surface, of a rotary lens-holder, and means to move the holder to contact the edge of the lens with the grinding-surface, and automatic means to increase the pressure of the contact as it shifts from the opposite ends of its long axis.

12. In a machine for grinding lenses, a rotary grindstone-shaft and a rotary lens-holder, a lever operatively connected to move the grindstone-shaft endwise, and a second shaft driven by the grindstone-shaft and operatively connected to rotate the lens-holder and to actuate the lever.

13. In a machine for grinding lenses, a rotary grindstone-shaft and a rotary lens-holder, a rocking support for the lens-holder, a bracket pivoted axially with the support, a housing pivoted axially with the grindstone-shaft, a second shaft journaled in the bracket and housing and operatively connected to be driven by the grindstone-shaft and to move the same axially, said second shaft being also operatively connected to rotate the lens-holder.

14. In a machine for grinding lenses, a rotary grindstone-shaft and a rotary lens-holder, a gear-case mounted on the shaft, a second shaft journaled in the gear-case, intermeshing gears secured to said shafts, additional intermeshing gears within the case one of which is secured to the second shaft, and a lever within the case actuated by the one of the additional gears and operatively connected to move the grindstone-shaft endwise.

15. In a lens-grinding machine, a grindstone-shaft, in combination with two intermeshing gears, one being secured to the shaft, two additional intermeshing gears driven by the former gears, one of the latter gears having a spiral groove, and a lever having one end riding in the groove and its other end operatively connected to move the grindstone-shaft endwise.

16. The combination with a rotary lens-holder, of a rotary grindstone-shaft movable axially to move the grindstone across the edge of the lens, and a second shaft driven

by the former shaft and connected to transmit rotary motion to the lens-holder.

17. The combination, with a rotary lens-holder, of a rotary grindstone-shaft movable axially to move the grindstone across the edge of the lens, a second shaft driven by the former shaft, connections for transmitting rotary motion from the second shaft to the lens-holder, and means to make and break said connections.

18. In a lens-grinding machine, a rotary lens-holder and a rocking support therefor, driving mechanism for the lens-holder including a clutch to throw the driving mechanism into and out of connection with the lens-holder, and means actuated by the rocking support when moved in one direction to throw the clutch from one position to another.

19. In a lens-grinding machine, the combination with a grindstone, a support movable toward and from the grindstone, a rotary lens-holder on the support, driving mechanism for the lens-holder including a clutch for disconnecting the driving mechanism, and means actuated by the support when moved from the grindstone for throwing the clutch out of action.

20. In a lens-grinding machine, the combination with a grinder, of separate rotary spindles having lens-clamping heads, a fixed sleeve, a rotary handpiece encircling one of the spindles and operatively connected to a fixed sleeve and to the inclosed spindle to move itself and the spindle which it encircles axially.

21. In a lens-grinding machine, the combination with a grinder, of separate rotary spindles having lens-clamping heads, a fixed sleeve, a rotary handpiece encircling one of the spindles and itself and the spindles which it encircles axially, and a spring between the

axially-movable spindle and handpiece whereby the lens is held between the heads under yielding pressure.

22. In a lens-grinding machine, the combination with a grinder, of separate rotary spindles having lens-clamping heads, a rotary handpiece encircling one of the spindles and operatively connected to move itself and the spindle which it encircles axially, a shoulder on the axially-movable spindle, an antifric-tion end-thrust bearing adjacent the shoulder, and a spring between the bearing and handpiece for the purpose set forth.

23. In a lens-grinding machine, the combination with a grinder, of separate rotary spindles having lens-clamping heads, a fixed threaded sleeve and a rotary threaded hand-piece both encircling one of the spindles and engaged with each other, the handpiece being operatively connected to move the spindle which it encircles endwise, and a spring between the axially-movable spindle and handpiece for the purpose set forth.

24. In combination with a grinding-surface and a rotary lens-holder, a former connected to and rotating with the lens-holder, a lever and a contact-piece mounted thereon, a fixed threaded stud, an indicator-disk concentric with the stud and fixed from rotation to the lever, and a graduated nut engaged with the threaded stem whereby the rotation of the nut on the stud operates to rock the lever for shifting the position of the contact-piece and indicating the size of the lens to be ground.

In witness whereof we have hereunto set our hands this 14th day of November, 1902.

ELI M. LONG.

CHAUNCEY W. HOWLAND.

Witnesses:

L. W. KEYES,

E. S. BOYDEN.