No. 881,646. PATENTED MAR. 10, 1908.

C. C. ALLEN.

# MACHINE FOR GRINDING LENSES.

APPLICATION FILED MAY 16, 1906.

2 SHEETS—SHEET 1.

*Fig. 2*

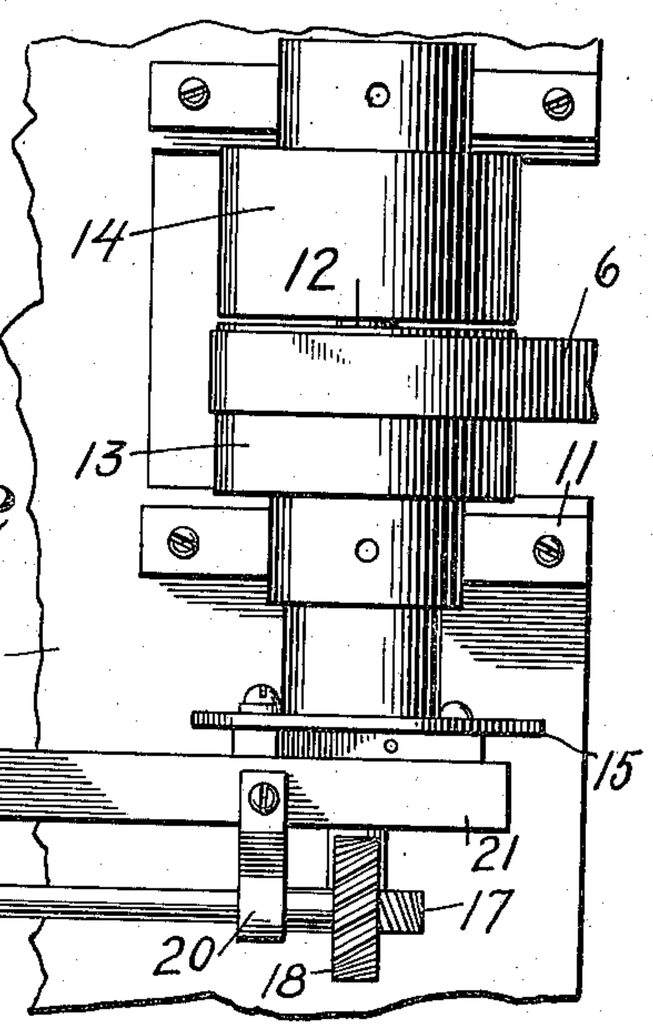



*Fig. 3*

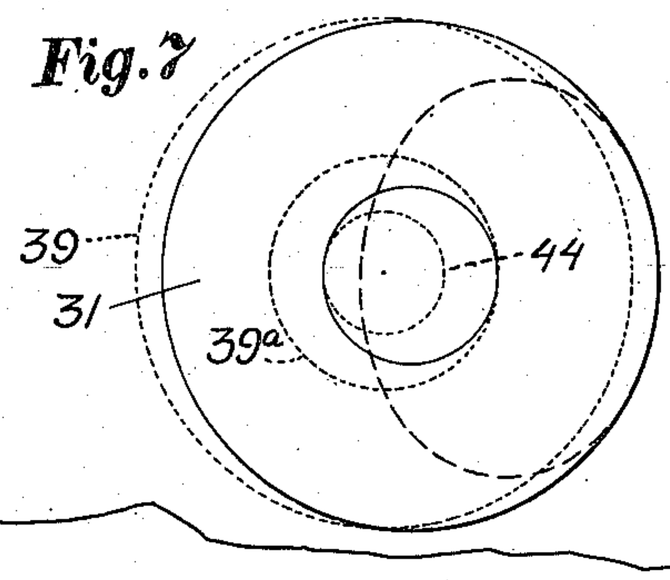
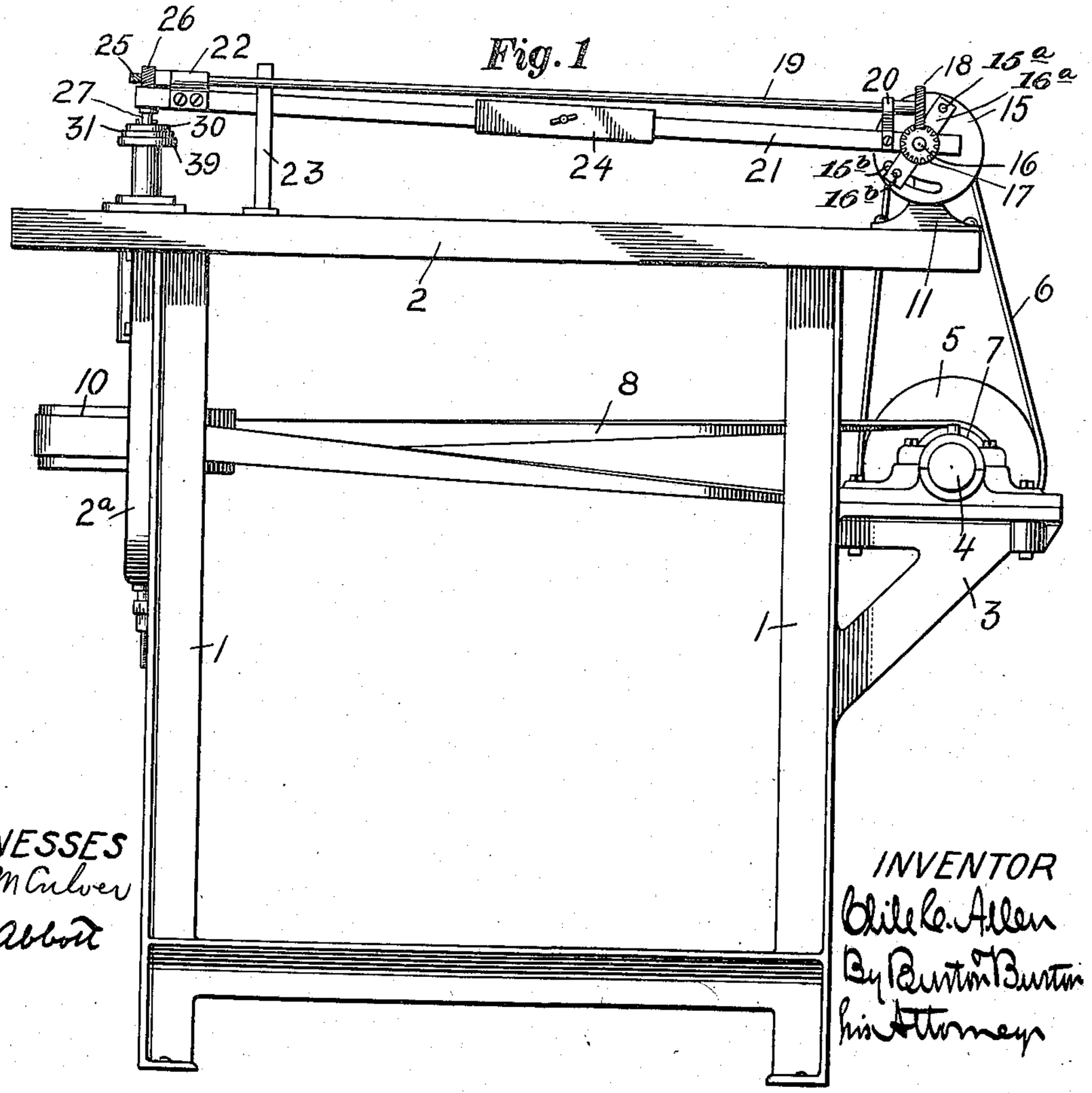



*Fig. 1*




WITNESSES
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2 SHEETS—SHEET 2.

Fig. 3

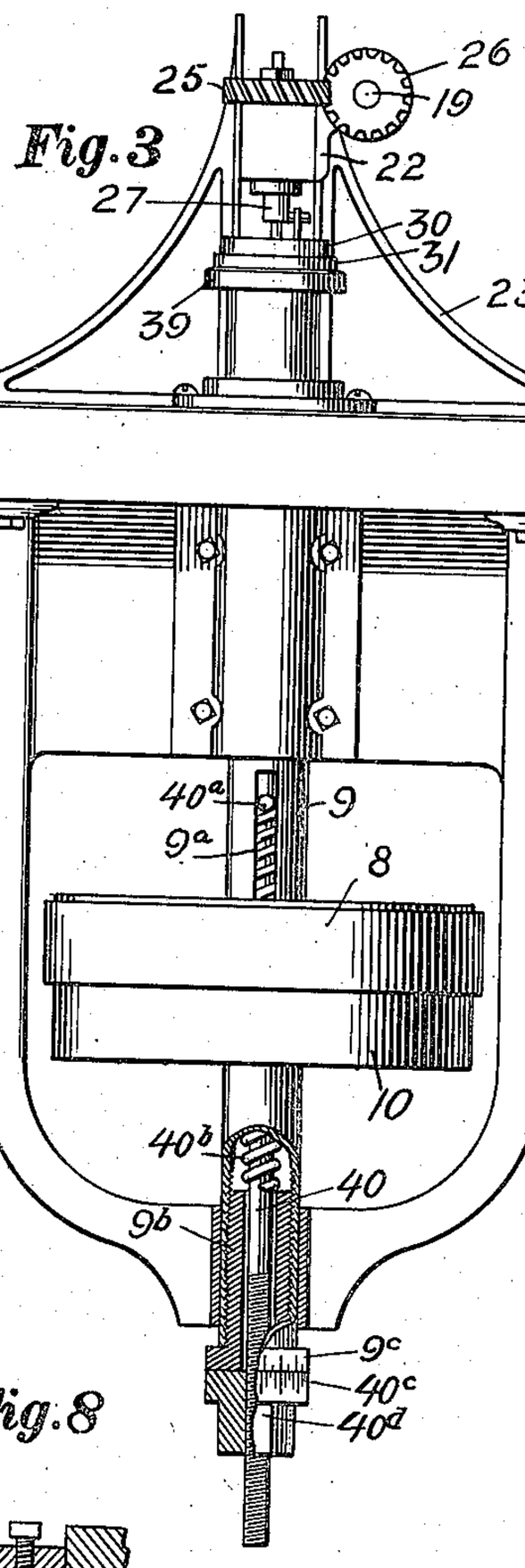
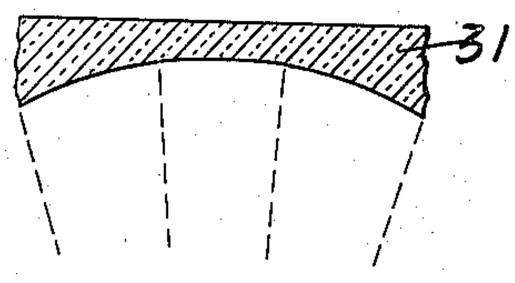



Fig. 6



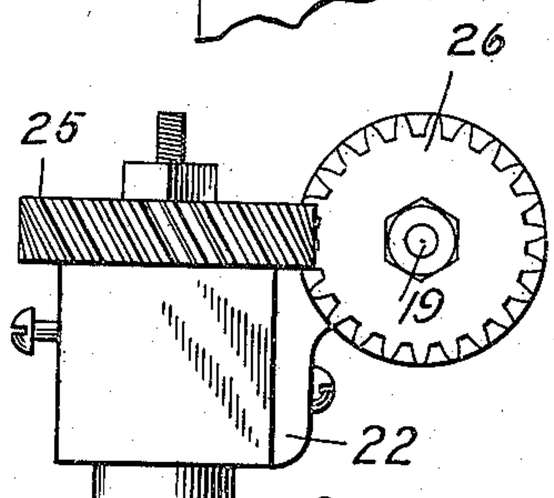




Fig. 4

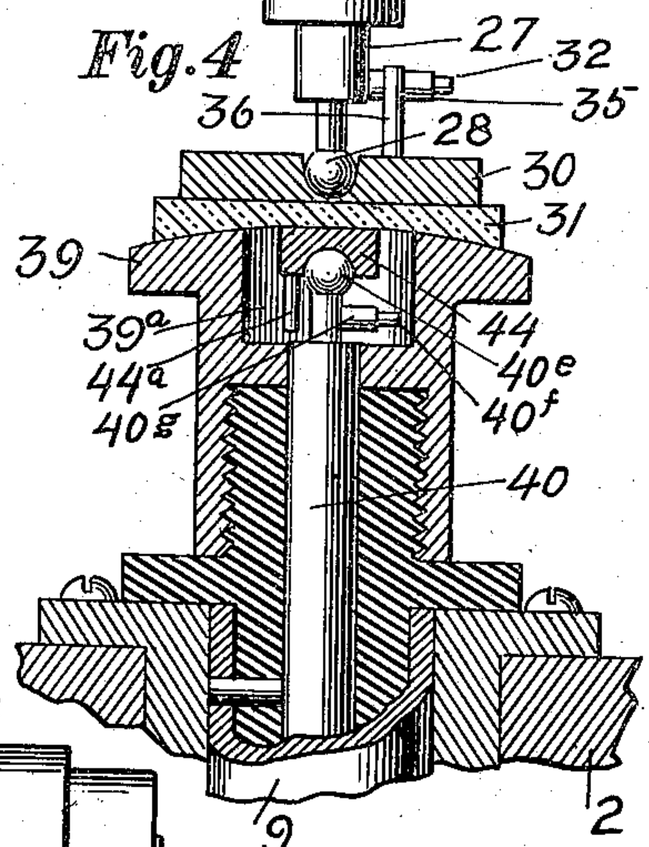



Fig. 8

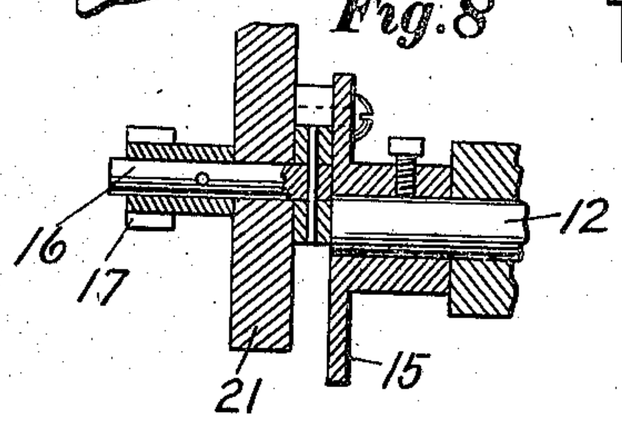
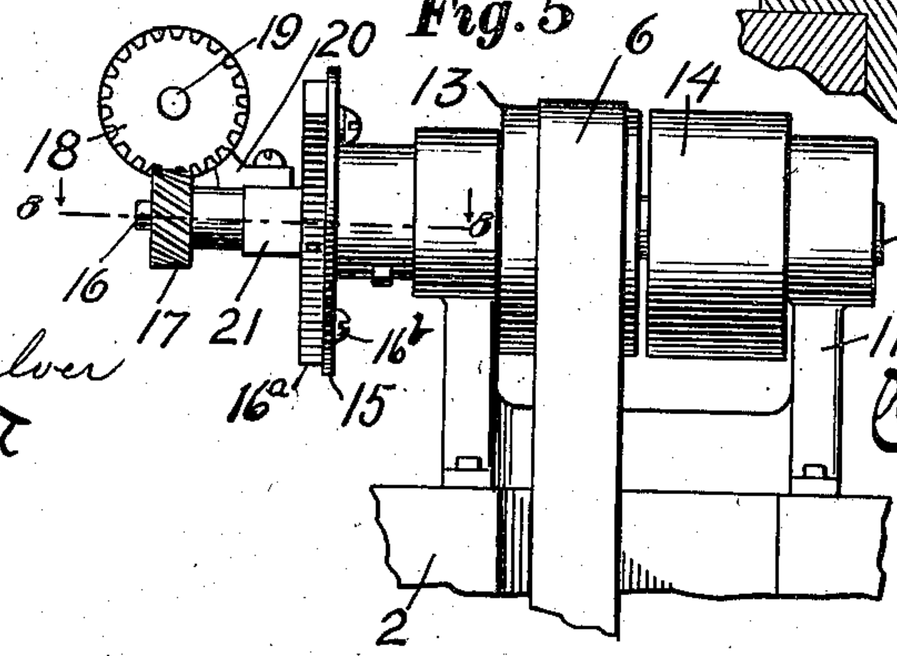



Fig. 5

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# UNITED STATES PATENT OFFICE.

CLILE C. ALLEN, OF CHICAGO, ILLINOIS, ASSIGNOR TO F. A. HARDY & COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## MACHINE FOR GRINDING LENSES.

No. 881,646. Specification of Letters Patent. Patented March 10, 1908.

Application filed May 16, 1906. Serial No. 317,052.

*To all whom it may concern:*

Be it known that I, CLILE C. ALLEN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Machines for Grinding Lenses, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved mechanism for the purpose of grinding lenses, for eye-glasses or other purposes, having different portions of the area ground for different focal distances so as to produce, in one piece, and without abrupt shoulder or offset between the two areas, lenses for eye-glasses adapted for use at both long and short range.

The invention consists in the features of construction and combination set out in the claims.

In the drawings:—Figure 1 is a side elevation of a machine embodying this invention. Fig. 2 is a plan view of the same with the table in part broken away. Fig. 3 is a forward end elevation with the base of the standard broken away. Fig. 4 is a partly sectional detail elevation of certain of the operating parts at the forward end above the table, section being made axially with respect to the lap carrier. Fig. 5 us a detail elevation of the power-communicating devices viewed from the rear end. Fig. 6 is an axial section of a portion of a lens operated upon in the machine. Fig. 7 is a plan view of the lens showing diagrammatically the manner of cutting the same to produce the desired form for use. Fig. 8 is a detail section at the line 8—8 on Fig. 5.

To assist in readily understanding the mechanism shown in the drawings and hereinafter to be described, the method and principle of the present invention may be first explained.

A blank of suitable glass for the lens, which has been, by any convenient means produced in or reduced to an outline approximating that to which it is to be brought by the use of the machine, is mounted for rotation by cementing it or causing it in any proper manner to become adherent to a rotating carrier, and at the side to be dressed is exposed to the action of suitably shaped grinding or polishing devices which comprise two parts,—to wit, an annular lap whose operating face is curved to the radius of curvature of the principal portion of the area of the lens, and a supplemental lap located in the opening of the annular lap having its operating face curved to the radius of curvature of the secondary or interior portion of the lens area to be produced. This supplemental lap is in some cases perfectly flat when that is the desired form of the interior or secondary portion of the lens. The interior or supplemental lap does not occupy the full opening of the annular lap, but is annularly spaced therefrom. Means are provided for relatively adjusting the two laps, first, for grinding by relative axial movement to keep their operating faces properly related to produce a continuous face on the lens, and, second, for polishing, so that their relative pressure may be varied at will. Between the lens carrier and the lap carrier there is provision for relative oscillation while both are rotating, the range of oscillation being substantially the width of the annular interval between the two elements of the lap, so that the inner or supplemental area of the lens to be dressed by the inner or supplemental lap has a diameter greater than that of the inner lap by the amount of the oscillation; and, similarly, the width of the outer annular area dressed by the outer annular lap is greater than the width of that lap by the amount of half that oscillation. This statement of result assumes absolutely accurate construction and movement of the parts; but the slight variation from accuracy which may be allowed may be compensated by equally slight increase of the range of oscillation beyond the width of the annular interval between the two laps, so that practically the two areas do not intrude upon each other, and a definite and clear line of demarcation exists between them without any shoulder or offset, the radius of curvature merely changing at that line.

The machine shown in the drawings comprises any suitable frame or stand, represented by the standards, 1, 1, and top, 2. Upon the rear end standard, in suitable brackets, 3, there is journaled the horizontal main shaft, 4, to which power is communicated in any convenient manner. On this shaft a pulley, 5, by means of a belt, 6, drives mechanism mounted on the top of the table, hereinafter described, and a pulley, 7, by a belt, 8, drives the vertical tool-holding or lap-operating shaft, 9, suitably journaled on the

hanger, $2^a$, mounted depending from the top, 2. On this shaft is a horizontal pulley, 10, by which it derives motion from the belt, 8. Upon the table top, 2, in a bearing bracket or chair, 11, there is journaled a shaft, 12, having tight and loose pulleys, 13, 14, about which the belt, 6, passes from the pulley, 5, to rotate the shaft, 12. On the end of the shaft there is mounted a crank plate, 15, and on the crank wrist, 16, which projects from the face of the plate there is rigid a twist gear, 17, which meshes with a twist gear, 18, said gear, 18, being mounted on the end of a shaft, 19, journaled in a bearing, 20, which is mounted on a bar, 21, which is connected pitmanwise with the crank wrist, 16, back of the twist gear, 17, so that any means being provided for holding the shaft, 19, and bar, 21, substantially parallel and with their remote ends supported, the rotation of the shaft, 12, with its crank-plate and crank-wrist, 16, will not only rotate the twist gear, 18, and its shaft, 19, but also in each revolution will operate the shaft, 19, and the bar, 21,—that is, the shaft with its bearing,—with the movement of a pitman,—that is, up and down the distance of the throw of the crank-wrist, and longitudinally with thrusting movement an equal distance. The throw of the crank wrist is made variable by mounting it on the plate, 15, by means of the bar, $16^a$, pivoted to the plate at $15^a$, and movable about its pivot and secured as thus adjusted, by a bolt, $16^b$, in the slot, $15^b$, of the plate. At the end of the bar, 21, and shaft, 19, remote from the shaft, 12, the bar carries a bearing, 22, in which the shaft, 19, is journaled, so that the shaft and bar are held parallel and move together in the pitmanlike movement derived as described.

Back of the bearing, 22, the bar, 21, is guided in a vertical fork of a bracket, 23, which is mounted upon the table, 2. Any convenient means, as the weight, 24, suspended from the bar, 21, may be employed to operate with a tendency to hold the forward end of the shaft and bar downward with such pressure as may be afforded by the weight. The bar, 21, also supports a bearing for a horizontal twist gear, 25; and the shaft, 19, has at the forward end a twist gear, 26, for engaging the twist gear, 25. At the lower end of the shaft, 27, of the twist gear, 25, it is provided with a knob or ball terminal, 28, which is adapted to seat in the back or upper side of a lens-holding block, 30, to the lower side or face of which a lens blank, 31, may be cemented for holding it while it is being dressed. The block, 30, is rotated by means of a finger or stud, 32, jutting off from the shaft, 27, and preferably carrying a sleeve or anti-friction roll, 35, which bears against a stud or drive-pin, 36, which projects upwardly from the block, 30. It will be seen that the lens blank, 31, carried and driven by the means described, will be free to oscillate in every direction about the ball, 28, and so as to accommodate itself in every respect to whatever is opposed to it for dressing it.

The shaft, 9, is hollow and is journaled and vertically stopped by its bearings in the hanger, $2^a$, being rotated as already described. On the upper end of the shaft there is mounted removably, so as to permit substitution at will, the outer or annular lap, 39, having the center opening, $39^a$. Extending through this hollow shaft is a shaft, 40, which derives rotative movement from the hollow shaft by means of a cross pin, $40^a$, in the shaft, 40, engaging a slot, $9^a$, in the shaft, 9. A spring, $40^b$, coiled around the shaft, 40, within the hollow shaft is stopped at the upper end by the cross pin and at the lower end is stopped on a bushing sleeve, $9^b$, screwed into the lower end of the shaft, 9. The distance to which it is thus screwed in determines the tension of the spring and the pressure, therefore, with which the shaft, 40, is pressed upward or resists pressure downward. A flange on the lower end of the bushing sleeve has a finely graduated scale, $9^c$, which may be read with a graduated scale, $40^c$, on a nut, $40^d$, which is screwed onto the shaft, 40, and which is designed to be screwed up or down thereon as the bushing sleeve is screwed up or down on the shaft, 9, so as to keep the two scales in proximity for reading to indicate fine adjustment of the supplemental lap relatively to the annular lap, the two graduated scales being constructed relatively in familiar manner for such purpose. This adjustment is employed for grinding, the spring, $40^b$, being for such use adjusted to such tension that it practically upholds the central lap positively, its upward thrust being positively limited also by the nut, $40^d$. When employing the device for polishing, the tension of the spring, $40^b$, will be relaxed considerably and the nut, $40^a$, will be adjusted so that the central lap could protrude relatively to the annular lap, and it is thus adapted to be stopped, not by the nut, as before, but by its contact with the face of the lens which is being polished, and the tension of the spring thus determines accurately the pressure with which the annular lap acts for polishing.

At the upper end of the shaft, 40, it terminates in a ball, $40^b$, upon which the inner lap, 44, is mounted, having its operating face upward. This lap is driven by a stud, $40^f$, which projects from the shaft, 40, below the knob, $40^e$, and encounters a pin, $44^a$, projecting downward from the lap, 44, and has, preferably, an antifriction sleeve, $40^g$, as illustrated, with which directly the encounter of the pin, $44^a$, occurs. This lap, it will be seen, has the same facility of accommodating itself to any surface pressing upon

its operating face, as the lens blank, 31, mounted on the block, 30, has for accommodating itself to the pressure of the lap below it.

In the operation of this mechanism with the lens blank mounted as indicated, it will be seen that the lens itself receives a relatively slow rotation about its axis, and at the same time, an oscillatory or reciprocating movement in a plane substantially at right angles to that of the axis, the range of the oscillatory movement being the throw of the crank-wrist, 16. This throw is designed to be substantially equal to the width of the annular interval between the two laps, 39 and 44, and by virtue of the rotary movement which the lens blank receives about its axis, this oscillatory or vibratory movement will cause the central lap, 44, to operate upon a circular area of the lens whose radius is the radius of the lap plus half the width of said annular interval, or one-half the crank-wrist stroke; and at the same time the outer annular lap, 39, by reason of the slow rotation and reciprocating or oscillating movement of the lens, will operate upon an annular area of the lens whose width is the width of the annular lap plus half said annular interval,—that is, half the crank-wrist stroke. In order that in grinding, the two laps shall operate so as to prevent any shoulder or offset between the areas which they respectively dress, the adjustment mentioned by means of the micrometer scale is employed; and in order that in polishing, the slower travel of all points of the inner lap in their circular path due to its smaller diameter may be compensated by greater pressure operating upon it, the inner lap is mounted so as to be pressed against the blank independently of the annular lap, and the variation of that pressure is made, as described, by adjusting the tension of the spring, $40^b$. The entire structure which carries the blank, consisting of the bar, 21, the shaft, 19, and the bearings mounted on the bar, being held down to the work only by the weight, 24, and that not positively, the entire device may be at any time swung up free of the laps, so that the operator can test the advancement of the work of the two grinders, and if it at any time appears that there is developing the slightest shoulder or offset between the surfaces dressed by them respectively, proper adjustment of the inner lap can be made to keep the two areas perfectly blending with each other at the circle by which they are delimited from each other,—that at which the radius of curvature changes. It will be understood that the oscillation described is so short that it does not interfere in any respect with the curvature, especially in view of the fact that the lens blank, 31, accommodates itself always to the actual curvature of the lap, 39, and would accommodate itself even through a much larger range of oscillation, and that in like manner, the lap, 44, accommodates itself to the slight change of angle of the surface on which it is operating, so that the oscillation is without effect upon the curvature.

I claim:—

1. In a machine for the purpose indicated, two opposed elements, one for carrying the lens and the other carrying an annular lap and an auxiliary lap located within the opening thereof and annularly spaced therefrom; means for oscillating one of said two opposed elements and means for rotating one of them.

2. In a machine for the purpose indicated, two opposed elements, one for carrying the lens and the other carrying an annular lap and an auxiliary lap located within the opening thereof, and annularly spaced therefrom; means for oscillating one of said two opposed elements and means for rotating the lens carrier.

3. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed and the other carrying an annular lap and an auxiliary lap located within the opening thereof; means for rotating one of said elements; means common to the two laps for yieldingly pressing them both against the lens; means for distributing such pressure in predetermined ratio to the lenses, and means adjustable at will for varying such ratio.

4. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed; an annular lap and an auxiliary lap located within the opening thereof carried by the other element; means for rotating one of said elements; means for yieldingly pressing the lens carrier toward the laps, and independent means for yieldingly pressing the auxiliary lap toward the lens.

5. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed; an annular lap and an auxiliary lap located within the opening thereof carried by the other element; means for rotating one of said elements; means for yieldingly pressing the lens-carrier toward the laps; independent means for yieldingly pressing the auxiliary laps toward the lens, and means for varying at will the pressure of said auxiliary element toward the lens.

6. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed and the other for carrying the laps for dressing it; means for oscillating one of said elements; means for rotating the lens-carrying element; an annular lap and a central lap having their operating faces annularly spaced apart, the range of oscillation of the oscillating element being substantially the width of said annular space, and means for yieldingly pressing the two elements

toward each other adapted to permit the central lap to be pressed toward the work independently of the annular lap.

7. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed and the other for carrying the laps for dressing it; means for oscillating one of said elements; means for rotating the lens-carrying element; an annular lap and a central lap having their grinding faces annularly spaced apart, the range of oscillation of the oscillating element being substantially the width of said annular space; means for yieldingly pressing the two elements toward each other adapted to permit the central lap to be pressed toward the work independently of the annular lap, and means for varying at will such pressure of the central lap.

8. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed and the other for carrying the laps for dressing it; means for yieldingly pressing said elements toward each other for holding the laps against the work; means for oscillating one of said elements; means for rotating both the elements; an annular lap and a central lap having their operating faces annularly spaced apart, the range of oscillation of the oscillating element being substantially the width of said annular space.

9. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed and the other for carrying the laps for dressing it; means for yieldingly pressing said elements toward each other for holding the laps in contact with the work; means for oscillating and rotating the lens-carrying elements; an annular lap and a central lap having their operating faces annularly spaced apart, the range of oscillation of the lens-carrier being substantially the width of said annular space.

10. In a machine for the purpose indicated, two opposed elements, one for carrying the lens to be dressed and the other for carrying the laps for dressing it; means for yieldingly pressing the lens-carrying element toward the other element; means for oscillating one of said elements; means for rotating the lens-carrying element; an annular lap and a central lap having their operating faces annularly spaced apart, the range of oscillation of the oscillating element being substantially the width of said annular space, and means for yieldingly pressing the central lap toward the work independently of the annular lap.

11. In a machine for the purpose indicated, a lens-carrier and a lap-carrier opposed to each other; means for oscillating and rotating the lens-carrier consisting of a rotating crank; a pitman pivoted on the crank; a power-communicating wheel rigid with the crank; a wheel having bearing on the pitman meshed with the power-communicating wheel for deriving movement therefrom; a shaft rotated by said second wheel having journal bearings on the pitman and extending along the same to the end thereof remote from the crank-wrist; a power-communicating wheel on said shaft at said remote end; a shaft mounted on the pitman at said remote end; a wheel on said shaft deriving movement from said last-mentioned wheel, the lens-carrier being carried by said shaft, and means for guiding and steadying the pitman.

12. In a machine for the purpose indicated, a lens-carrier and a lap-carrier opposed to each other; means for oscillating and rotating the lens-carrier consisting of a rotating crank; a pitman pivoted on the crank; a twist-gear having bearing on the pitman and meshed with the twist gear on the crank; a shaft rigid with the last-mentioned twist gear having journal bearings on the pitman and extending along the same to the end thereof remote from the crank-wrist; a twist-gear on said shaft at said remote end; a second shaft mounted on the pitman at said remote end, and a second twist-gear thereon deriving movement from the last-mentioned twist-gear, the lens-carrier deriving movement from said second shaft, and means for guiding and steadying the pitman.

13. In a machine for the purpose indicated, a lens-carrier and a lap-carrier opposed to each other; means for oscillating and rotating the lens-carrier consisting of a rotating crank; a pitman on the crank; a power-communicating wheel rigid with the crank; a second wheel having bearing on the pitman meshed with the power-communicating wheel for deriving movement therefrom; a shaft rotated by said second wheel having journal bearings on the pitman and extending along the same to the end thereof remote from the crank-wrist; a power-communicating wheel on said shaft at said remote end; a second shaft journaled on the pitman at said remote end, and a wheel thereon deriving movement from said last-mentioned wheel, the lens-carrier being carried by said shaft; means for guiding and steadying the pitman, and means for yieldingly holding the pitman toward the lap.

14. In a machine for the purpose indicated, a lens-carrier and a grinder-carrier opposed to each other; means for oscillating and rotating the lens-carrier consisting of a rotating crank; a pitman on the crank; a power-communicating wheel rigid with the crank; a second wheel having bearing on the pitman meshed with the power-communicating wheel for deriving movement therefrom; a shaft rotated by said second wheel having journal bearings on the pitman and extending along the same to the end thereof remote from the crank-wrist; a power-communicating wheel on said shaft at said remote end; a

shaft journaled on the pitman at said remote end, and a wheel therefrom deriving movement from said last-mentioned wheel, the lens-carrier being carried by said shaft; means for guiding and steadying the pitman; means for yieldingly holding the pitman toward the grinder, and a weight mounted movably on the pitman for pressing its free end yieldingly toward the grinder.

15. In a machine for the purpose indicated, in combination with two opposed elements, one for carrying the lens to be dressed and the other for carrying the laps for dressing it, means for yieldingly pressing the lens-carrying element toward the other, the lap-carrying element comprising a hollow shaft and an annular lap carried thereby; a spindle extending through the hollow shaft and a central lap carried thereby; means for rotating the hollow shaft and for communicating its rotation to the spindle, said means last mentioned being adapted to permit the longitudinal movement of the central shaft relatively to the other; a spring coiled about the spindle within the hollow shaft, and a bushing screwed into the hollow shaft for stopping and adjusting the spring.

16. In a machine for the purpose indicated, in combination with two opposed elements, one for carrying the lens to be dressed and the other for carrying the laps for dressing it; means for yieldingly pressing the lens-carrying element toward the other, the lap-carrying element comprising a hollow shaft and an annular lap carried thereby; a spindle extending through the hollow shaft and a central lap carried thereby; means for rotating the hollow shaft and for communicating its rotation to the spindle, said means last mentioned being adapted to permit the longitudinal movement of the central shaft relatively to the other; a spring coiled about the spindle within the hollow shaft; a bushing screwed into the hollow shaft for stopping and adjusting the spring, and a nut screwed onto the end of the spindle which protrudes through the bushing, said bushing and nut having coöperating elements of a micrometer scale.

In testimony whereof, I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 11th day of May, 1906.

CLILE C. ALLEN.

In the presence of—

CHAS. S. BURTON,

M. GERTRUDE ADY.