Sept. 11, 1934. J. DI SANTO 1,973,527

LENS GRINDING MACHINE

Filed Dec. 30, 1931 5 Sheets-Sheet 1

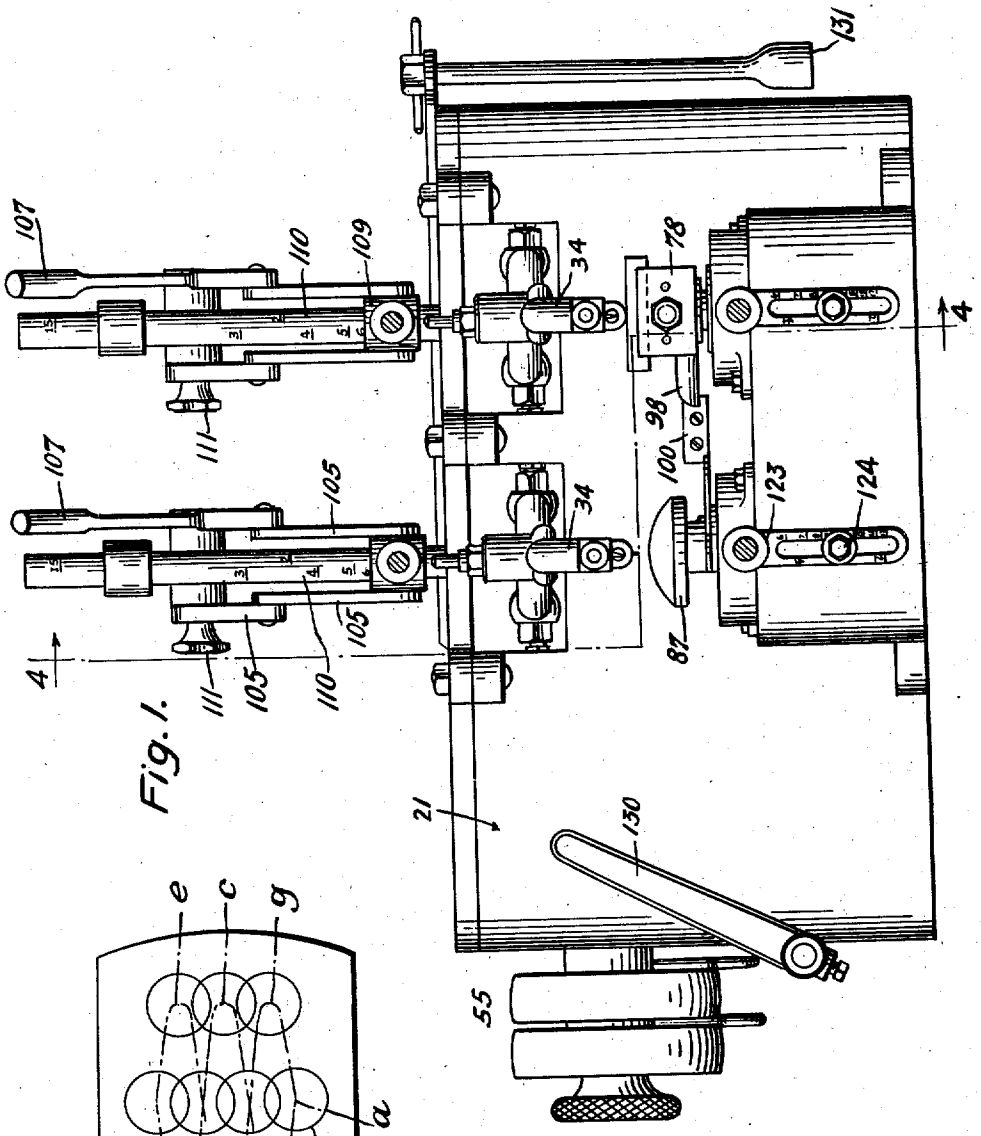


Fig. I.

Fig. II.

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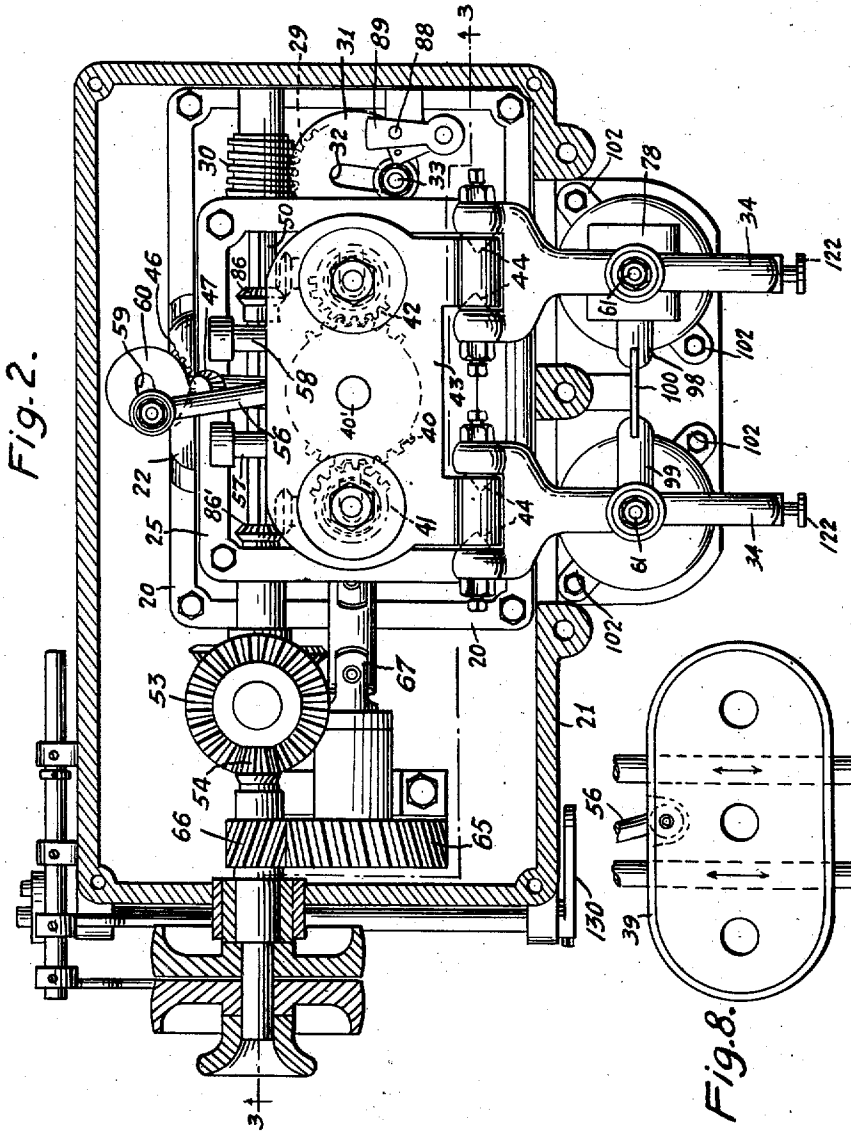


Fig. 2.

Fig. 8.

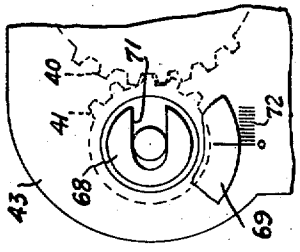


Fig. 10.

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LENS GRINDING MACHINE

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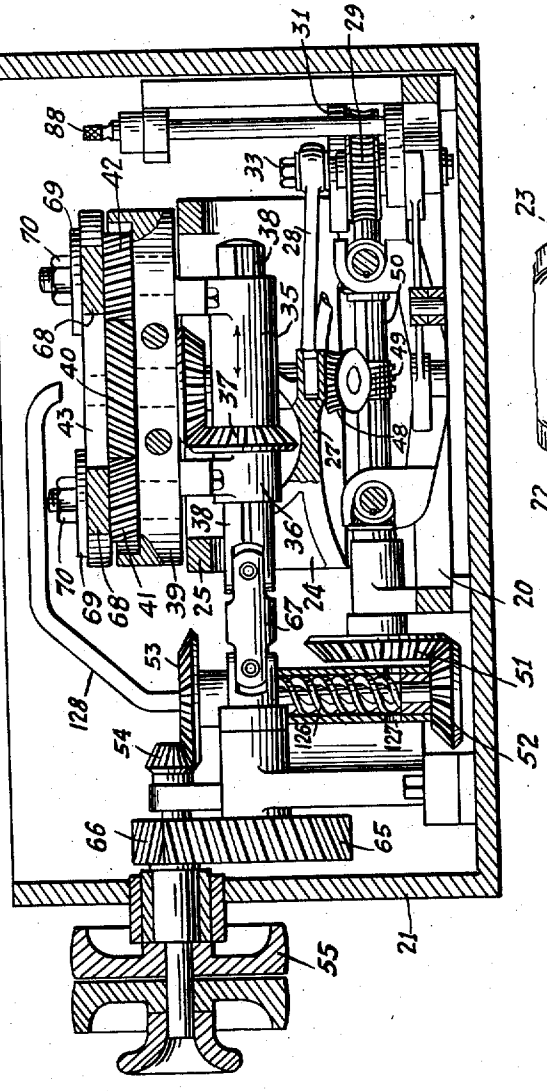


Fig. 3.

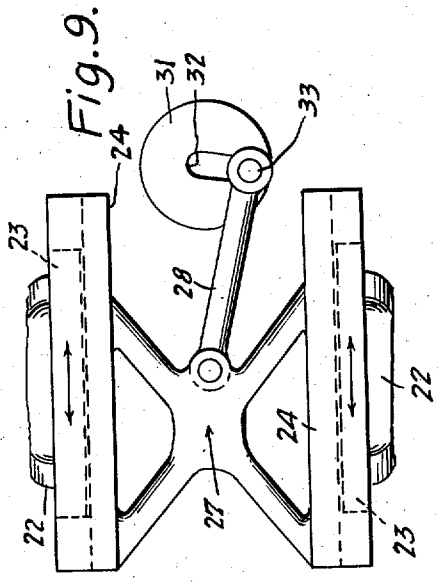


Fig. 9.

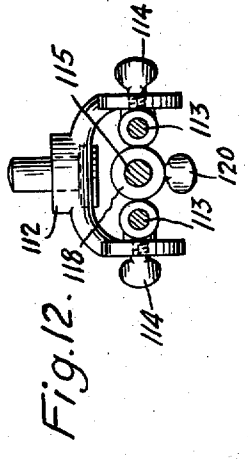


Fig. 12.

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LENS GRINDING MACHINE

Filed Dec. 30, 1931 5 Sheets-Sheet 4

Fig. 7.

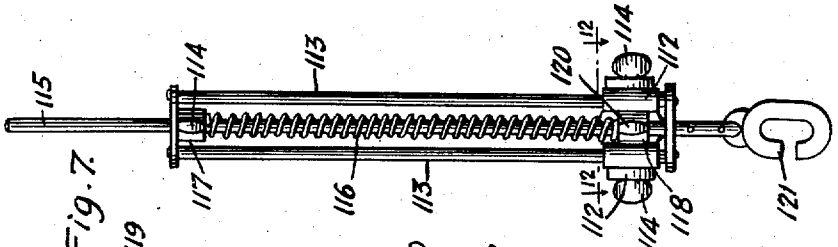


Fig. 4.

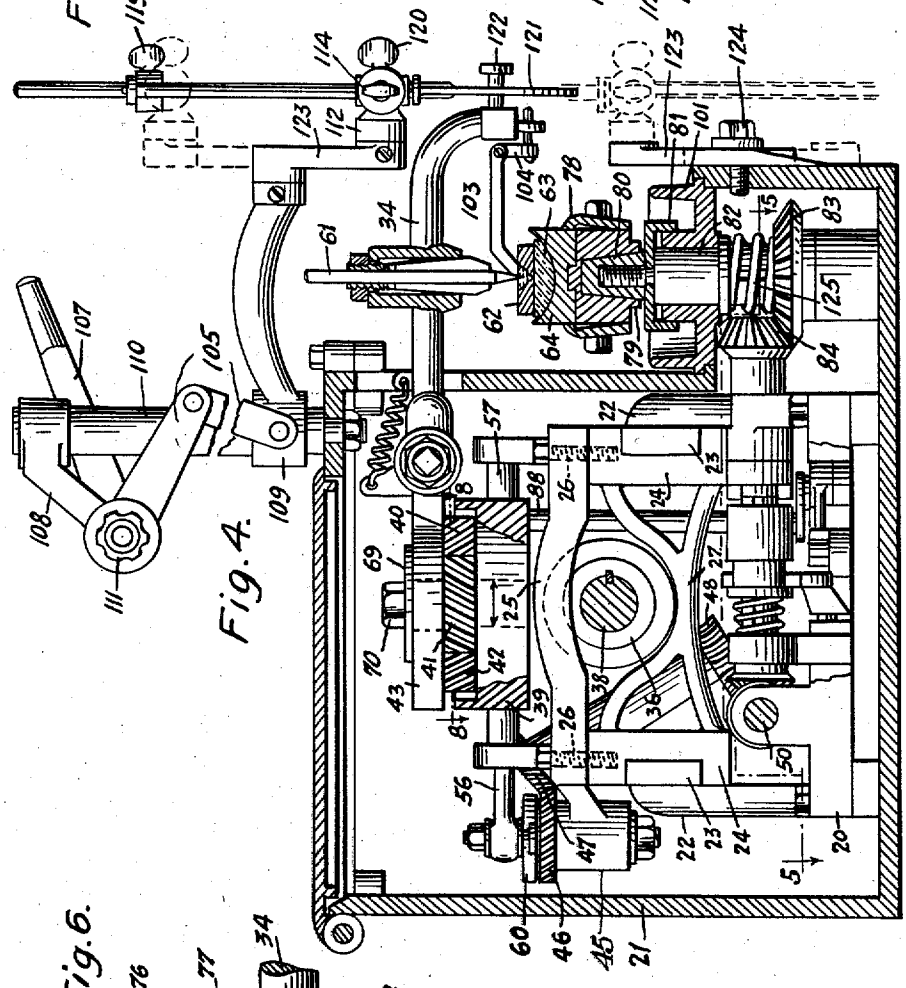
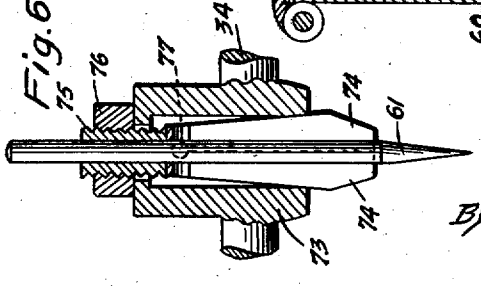


Fig. 6.



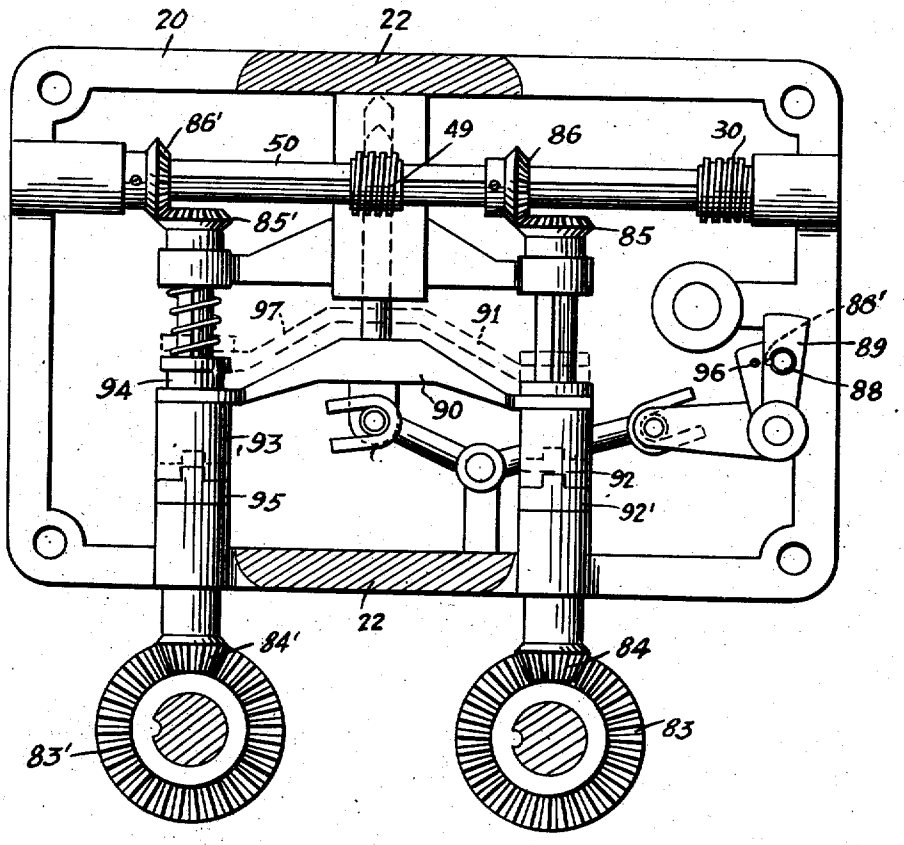
Inventor:
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LENS GRINDING MACHINE

Filed Dec. 30, 1931 5 Sheets-Sheet 5

Fig. 5.



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Patented Sept. 11, 1934 1,973,527

UNITED STATES PATENT OFFICE

1,973,527

LENS GRINDING MACHINE

Joseph Di Santo, New York, N. Y.

Application December 30, 1931, Serial No. 583,822

7 Claims. (Cl. 51—121)

This invention relates to a new and useful lens grinding machine and has for its object the provision of a construction for automatically grinding, both spherical and cylindrical lenses simultaneously, or independently of each other, without the substitution or addition of parts to the machine.

Another object is the provision of a lens grinding apparatus whereby I am able to grind and finish lenses to a high degree of perfection in one and the same operation with a considerable saving of time, labor and grinding material.

A further object of the invention resides in the provision of means for distributing the grinding effect over the lap surface at a predetermined ratio of rectilinear components of motion in combination with circular motions.

Another object resides in the provision of means for applying uniformity of pressure to the lens in its various positions during the grinding thereof, whereby uniformity of grinding and wearing of the grinding lap is had.

Another object includes a method of grinding lenses to a required standard and uniformity of surface.

A further purpose of the invention is the provision of impact absorbing means for the lap to overcome any excessive pressure on the lens in the grinding operations.

I further provide a coupling mechanism for controlling a pair of grinding spindles so that they will both grind sphericals or cylindricals at the same time, or either of them may be employed for grinding one or the other form of lenses.

I further provide means for controlling the pressure of the lens on the grinding lap; I also provide means for locating the center of curvature and the radial length of said grinding lap on which the lens is ground.

My improved construction also provides for a substantially noiseless self-lubricating machine.

Other objects will appear hereinafter, and I obtain these objects by a construction illustrated in the accompanying drawings, in which

Figure 1 is a view in front elevation of a machine embracing my invention, but having the pressure spindles removed for clearness;

Fig. 2 is a plan view thereof with the cover plate and attached pressure posts removed and the oil feed pipe omitted;

Fig. 3 is a view taken on the line 3—3 of Fig. 2 looking in the direction of the arrows;

Fig. 4 is a view taken on the line 4—4 of Fig. 1;

Fig. 5 is a plan view of the coupling for connecting and disconnecting the grinding spindles taken on the line 5—5 of Fig. 4, but showing the couplings both closed;

Fig. 6 is a detailed view of the lens body holding and centering pin in its socket;

Fig. 7 is a view in front elevation of the pressure spindle and the radius centering means;

Fig. 8 is a plan view of the gear plate and connections therefor;

Fig. 9 is a view showing the relation of the side plates and the bracket or spider, together with the driving mechanism for reciprocating the spider and attached plates;

Fig. 10 is an enlarged view of a portion of the top plate showing the slotted bearing for giving to the plate its eccentric rotary motion;

Fig. 11 is a graphic representation showing the path of the top plate and therefore of the lens and the centering pin carried through one complete cycle of compounded motions; and

Fig. 12 is an enlarged view taken on the line 12—12 of Fig. 7 viewed in the direction of the arrows and showing the yoke for adjusting the length of radius.

Similar reference characters refer to like parts throughout the several views wherever they appear.

It is one of the prime purposes of my invention to produce a highly efficient lens grinding machine which is automatic in operation and capable of grinding lenses, either in pairs or separately, of the same type or of different types as may be desired. The grinding is effected by compounded rectilinear and circular motions which are imparted by the machine to the abrading surface while uniformity of pressure is maintained on the lens surface throughout the cycle of operations. This uniformity of pressure is essential to the production of lenses of standard quality and uniformity of surface and is had in my invention when the pressure spindle is set at the point of oscillation to give the radius of curvature of the lap on which the lens is ground, as will appear more fully hereinafter.

Referring, now, to the accompanying drawings, I provide a suitable support or base frame 20 in the bottom of housing 21. This frame is provided with oppositely disposed guide posts 22, 22 having guide plates 23, 23 integrally connected therewith. On each guide plate there is slidably mounted a side plate 24. The side plates support the carriage frame 25 and are suitably united thereto by bolts 26, 26.

As will appear best from Figs. 4 and 9, the side plates 24 are held in parallel relation by a

bracket or spider 27, and the spider and attached side plates are reciprocated longitudinally on guide plates 23 by pitman arm 28, gear 29 and worm 30. Gear 29 is provided with a disc 31 of suitable size. Said disc has a slot 32 in which the adjustable pitman bolt 33 is held for varying the longitudinal reciprocation or throw. This longitudinal reciprocating throw or motion is imparted by the carriage frame directly to the grinding arms 34, 34 and to attached parts, including the means for at the same time giving to said grinding arms transverse throw or rectilinear motions at right angles to the aforesaid longitudinal throw, and the means for at the same time giving the circular motions also to the grinding arms.

By referring to Figs. 2, 3 and 4, it will be noted that the reciprocating carriage 25 carries with it gear sleeves 35 and 36, drive gear 37 (which is slidably mounted on drive shaft 38), gear plate 39 (which supports the central drive gear 40 and side gears 41 and 42), top plate 43 and the grinding arms 34 pivoted thereon at the pivot points 44, 44. The carriage frame also carries bushing 45 for the pitman gear 46, which is driven by pinion 47, worm 49 and gear 48. Worm 49 is slidably mounted on shaft 50 which is driven through suitable means as bevel gears 51, 52, 53, pinion 54 and a suitable source of power through pulley 55.

It will be noted that when shaft 50 is rotated, as when the machine is operated, that worm 30 on shaft 50 through gear 29 will impart the longitudinal reciprocating throw to the spider, the side plates, the carriage frame and attached parts, including the gear plate and its gears, the top plate and grinding arms At the same time, worm 49, also on shaft 50, will drive the pitman gear 46 through gears 47 and 48 and operate the pitman arm 56 to give the transverse throw to the gear plate, the top plate and the grinding arms. As is best shown by Figs. 2 and 8, gear plate 39 is supported on bars 57 and 58 for the transverse reciprocating motion or throw. By adjusting the pitman arm in slot 59 of disc 60 the length of throw is varied, as may be desired, and the length of the transverse throw may be equal to the longitudinal throw or it may be greater or less.

A preferred form of construction is such that the longitudinal throw is greater than its transverse throw. One way of accomplishing this is by providing a longer slot and greater pitman disc for the longitudinal throw (see Fig. 2) mechanism than that for the transverse throw and adjusting the pitman arms on their respective discs for the desired lengths of the throws.

The construction just described provides for the distribution of the grinding effect on the grinding lap along the rectilinear lines of motion, or the longitudinal throw and the transverse throw of the grinding arms. Since the grinding arms carry the lens holding or centering pin 61, the point of which bears on the lens body 62, the motion of each lens grinding arm is imparted through the lens holding and guiding or centering pin to the lens 63, which, since it is fastened to the lens body 62, is moved over the surface of the lens grinding lap 64 in accordance with the rectilinear motions of the lens and its centering pin.

In addition to the two rectilinear motions just described, the lens body and, therefore, the grinding arms and lens holding pins are given a circular motion which is imparted to the top plate 43 by means of central drive gear 40 and the two side gears 41 and 42. These gears are driven from the bevel gear 37, drive shaft 38 and drive gears 65 and 66. It will be noted that drive shaft 38 has a coupling 67 to allow for the transverse reciprocation of the end portion of shaft 38, sleeves 35 and 36, gear 37 and the remaining parts carried by the gear plate 39.

The top plate 43 and attached grinding arms are given concentric motions when the end gears 41 and 42 are rotated and the plate is held off center in a suitable manner. One way of doing this is as follows: On each of gears 41 and 42 there is provided a holding and bearing washer 68. This washer is fastened by the nut flange 69 and nut 70 on the gear 41 (and 42) to rotate therewith and thus forms bearings for the top plate. By referring to Fig. 10 it will be noted that the washer 68 is provided with a slot 71 for lateral adjustment of the top plate when the nuts are loosened. This adjustment will change the point of center of the washers and will cause the top plate to move in a circular path when the gear is rotated with the washers off center. The diameter of the circle is varied by the distance that the top plate is moved and therefore the distance that the washers are displaced eccentrically. This position is indicated by a scale 72 on the top plate and as shown the top plate is set at zero which means that the plate does not move concentrically. To move concentrically the washers must be set off center. This is done by loosening the nuts 70 and then setting the plate to the scale desired. This will carry the bearing washers off center along their slots. The nuts are then fastened and the top plate will move concentrically on the eccentric washers, thus giving a circular motion to the top plate when the machine is operated. This circular motion will be imparted to the grinding arms, and, therefore, also to the centering pin and the lens. However, because of the longitudinal and transverse motions of the top plate and, therefore, also of the pin and lens, the circles will not be concentric but will form elongated loops across the face of the grinding lap. The shape and path of these loops will be determined by the relative, simultaneously circular and longitudinal and transverse motions. As a practical example, the circular motion of the top plate (and therefore of the lens) may be as high as six hundred (600) revolutions per minute while the longitudinal and transverse motions are relatively slow. Preferably, though not necessarily, I so time the longitudinal motions of carriage 25 and therefore of the top plate and the lens, that the lens will move longitudinally across the face of the lap any selected or desired number of times for each transverse back and front motion of the gear plate 39. These relative, longitudinal and transverse motions distribute the circular grinding effect over the lap surface and thereby produce lenses of standard quality and uniformity of surface.

In Fig. 11 I have shown a preferred mode of operation wherein is illustrated, more or less graphically, the path of the centering pin and, therefore, also of the lens over the face of the grinding lap 64'. Here the loops 71 represent the path of the pin and lens moving rapidly in circular paths which are traced diagonally over the face of the lap at a given rate of longitudinal and transverse motions. The ratio of the longitudinal motion or throw to that of the transverse motion or throw is, in the specific example illustrated, as 3 to 1. Obviously, other ratio values may be taken to distribute the grinding effect and the grinding may be started at any

position on the lap. If in the diagrammatic representation of these motions as traced in Fig. 11, I let —*a*— represent the starting position, then will the dotted line *a*—*b*—*c*—, etc., represent the path along which the helical loops 71 are traced for effective grinding.

It will be noted that the rectilinear motions will distribute the grinding over the surface of the lap and the circular motions will better spread the grinding material without waste and thus give uniformity of operation. I regard this feature as an important discovery which is very effective when taken with my means for maintaining uniformity of pressure and my radius centering means. In this connection it should be also noted that the lap may be rotated on its axis or it may be held stationary for grinding sphericals or cylindricals respectively. Moreover, the grinding surface may be convex or concave, depending upon the kind of lenses to be ground.

The lens is centered or held and guided by pin 61 which is seated in socket 73 by four wedges 74 held in clamped position by the screw threaded neck 75 being tightened by nut 76 as is best shown in Fig. 6. Wedges 74 are provided with weakening apertures 77 to give more flexibility thereto. In order to adjust the centering pin to a proper position in socket 73, nut 76 is loosened sufficiently to permit the pin to seek its level in the seat in lens body 62. The nut 76 is then fastened in the usual manner.

The grinding lap, such as is shown at 64, may be held in position on the grinding table 79 by clamps 78. Grinding table 79 is seated on a thimble 80 which is threaded to engage the screw on hub 82, thereby clamping the cover 81 to protect the hub and associated parts. The hub 82 is driven by drive gear 83 which obtains its power through pinions 84, 85, and 86. The latter pinion is fastened on drive shaft 50.

By referring to Fig. 5 it will be noted that drive pinions 83', 84', 85' and 86' are provided for operating the companion table or lap 87 (see Fig. 1). Since the laps are interchangeable my device may easily be converted into apparatus for grinding sphericals or cylindricals simultaneously, or for grinding either spherical and the other cylindrical or the reverse. By a simple arrangement of gear throw, illustrated best in Fig. 5, it is possible to shift from two rotating, grinding laps to one rotating, grinding lap and eventually to have both tables or laps non-rotating. This may be accomplished by moving handle 88 from the position shown in Fig. 5 to position 88' shown by a dotted line. This will move the lever 89 and raise the yoke 90 to the position indicated by the dotted line 91. This operation will separate sleeve 92 from 92' to open position. It will also raise sleeve 93 on sleeve 94 without separating the driving connections between sleeve 94 and sleeve 95 so that gear or pinion 84' will still be operating while 84 is held stationary. If it is now desired to hold gear 84' also stationary, the handle 88 is moved to the third position 96. This will raise the yoke 90 to the second dotted line position 97 and disconnect sleeves 93 and 94 from 95. Both laps are now in position for grinding cylindricals. This position is maintained in any suitable manner as, for example, by a lap clamp finger 98 (Fig. 2) and the flat guiding finger 99. These two fingers are held on the frame in any suitable manner as by blade 100.

From this construction it will be clear that both grinding units may be readily converted for grinding cylindricals or sphericals and either convex lens or concave lens.

In order to collect any grinding material which may be spilled from the table, I provide a bowl 101 (Fig. 4) on hub 82 which bowl is fastened to the frame by suitable means as ears 102 (Fig. 2). The lens itself may be kept in axial position against rotation by any suitable means such as fork 103 engaging the lens body 62 and supported in any suitable manner as by means of a bracket 104 on the end of the grinding arm 34.

To obtain lenses of the desired quality and uniformity of surface, I set the radius adjusting or centering means and the pressure adjusting means so that the pressure spindle will oscillate from a point where it will give the real radius of curvature on which the lens is ground. This radius centering position may be secured by properly adjusting the several parts, including arm 106, lever 107, link 108, collar 109, toggle links 105, bracket 123 and sleeves 112. For extra radial lengths bracket 123 may be set up as shown in dotted lines on Fig. 4. In order to secure the proper position of the radius adjusting means, I provide a set nut 111 for adjusting the position of the radius centering arm 106 and collar 109 on the radius centering post 110 to the position required by the grinding lap and called for by the lens to the ground. For this purpose, posts 110 are provided with a series of numerals indicating the radius required for the dioptre curve to which the lens is to be ground. By setting the sleeve 109 to the numbers indicated in, say, the left-hand column on the radius centering posts, I get the readings direct. The set nut 111 is then fastened and the radius adjusting sleeves 112 will take their position on the frame 113,—the thumb nuts 114 having been previously loosened so that the sleeves may slide freely on frames 113.

This will automatically locate the center on which the radius operates. The thumb nuts 114 are then fastened and the pressure means adjusted.

In order to obtain uniformity of pressure, I have devised the pressure adjusting means illustrated in Fig. 7. This comprises a pressure spindle 115 carrying thereon spring 116, upper sleeve 117 and lower sleeve 118. These sleeves respectively are provided with thumb screws 119 and 120. One end of the pressure spindle 115 is provided with a C-shaped hook or bracket 121, the upper curve of which is seated against pin 122, which projects from the end of the pressure arm 34. In order to obtain the proper pressure of the lens on the grinding lap, experience and judgment are necessary. The operator will loosen thumb screw 120 in sleeve 118 and slide the sleeve into proper position on the pressure spindle 115. The screw is then fastened and if proper pressure is obtained the grinding material will be distributed evenly over the lap surface. The pressure means just described may be placed upside down as is shown by dotted lines on Fig. 4 for grinding concave lenses. In this position bracket 123 is fastened to the frame by suitable means as a bolt and nut 124 and pressure on the grinding arm and the lens will be formed below through the C-shaped hook.

I further provide the hub of the grinding spindle with a coiled spring 125 to take up sudden pressure shocks due to the inequalities on the grinding surface.

The apparatus is run under oil. For this pur-

pose the housing 120 is partially filled with oil to a proper level so as to submerge the machinery. As is best shown in Fig. 3, I provide a circulating pump 126 which takes in oil through apertures 127 and distributes the same by an oil pipe 128 to gears 40, 41 and 42 through an opening 40' in the gear plate.

A belt shifting lever 130 provides means for throwing the belt off and on to the driving pulley 131 and wrench 132 is conveniently placed for loosening or adjusting the nuts of the casing and of the pitman discs.

Having now described my invention what I claim as new and useful and desire to secure by United States Letters Patent is:

1. In a lens grinding machine, a lap for grinding lenses, means for rotating said lap, means for centering said lenses on the grinding lap, means for moving said lens in circular paths over the lap surface, means for distributing said circular paths along right lines disposed transversely across the face of the lap and means for maintaining uniformity of pressure on the grinding lap.

2. In a lens grinding machine, the combination of a base frame having oppositely disposed guide posts spaced apart, guide plates carried by said guide posts, a pair of side plates slidably mounted on said guide plates, a carriage frame uniting said side plates and mounted to reciprocate therewith, a gear plate mounted to reciprocate with said carriage frame, means for reciprocating said gear plate transversely to the motion of said carriage frame and means for at the same time moving said gear plate eccentrically.

3. A lens grinding machine according to claim 2 characterized by means for imparting the motions of the gear plate to a lens positioned on the grinding lap.

4. In a lens grinding machine, the combination of a base frame having oppositely disposed guide posts spaced apart, guide plates carried by said posts, a pair of side plates slidably mounted on said guide plates, a carriage frame uniting said side plates and mounted to reciprocate therewith, a gear plate carried on said carriage frame to reciprocate therewith, means to simultaneously reciprocate the gear plate at right angles to the path of the reciprocating carriage frame and side plates, end gears mounted in said gear plate to move therewith, a top plate supported on said end gears, seats in said top plate, bearing members in said seats, and means for adjustably fastening said bearing members off center on the end gears to thereby impart concentric circular motions to the top plate when the gears are rotated.

5. A lens grinding machine according to claim 4 characterized by the provision of means for transmitting the circular and rectilinear motions of the top plate to a lens in grinding.

6. In a lens grinding machine, a plurality of tool holding members and driving gears having interlocking gear sleeves, a gear throw for holding said gear sleeves in operative position, and means operated by the gear throw for disengaging one of said gear sleeves while the other is maintained in operative position.

7. A lens grinding machine according to claim 2 characterized by means for varying the ratio of the reciprocation of the gear plate with the carriage frame in its transverse reciprocation thereof.

JOSEPH DI SANTO.

Certificate of Correction

Patent No. 1,973,527. September 11, 1934.

JOSEPH DI SANTO

It is hereby certified that errors appear in the above numbered patent requiring correction as follows: In the drawings the gears 53, 54, Figures 2 and 3, gear 37 and its mating gear, gears 51, 52, 53, and 54, in Figure 3, and gears 83, 84, 83', 84', 85, 86, 85', and 86', of Figure 5, are spiral toothed bevel gears, instead of straight toothed bevel gears as shown in the drawings; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of November, A. D. 1934.

[SEAL] LESLIE FRAZER,
Acting Commissioner of Patents.

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[SEAL] LESLIE FRAZER,
Acting Commissioner of Patents.