

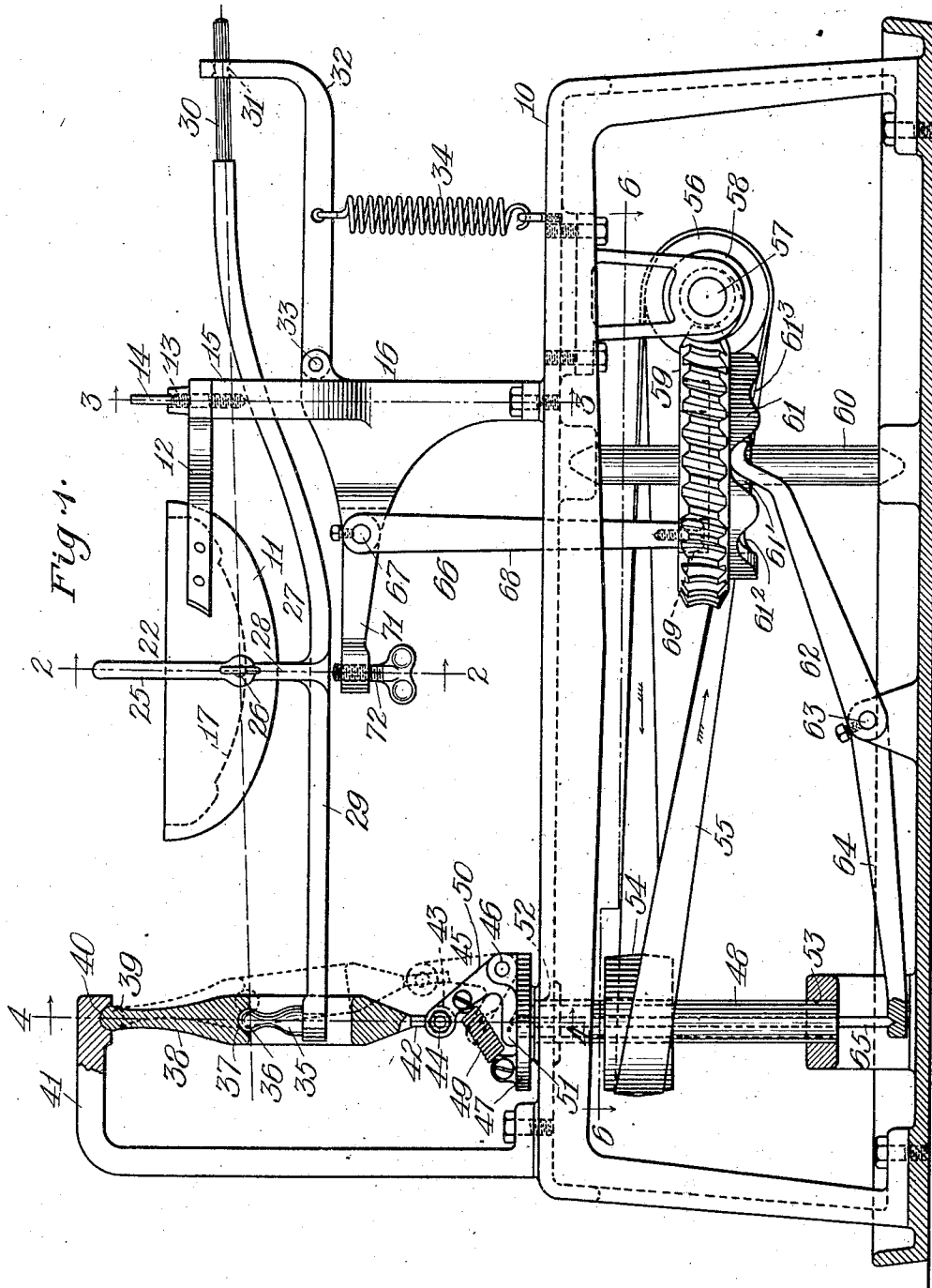
No. 857,791.

PATENTED JUNE 25, 1907.

F. M. CLARK.
MACHINE FOR GRINDING LENSES.

APPLICATION FILED MAR. 19, 1906.

3 SHEETS—SHEET 1.



Witnesses:

William B. Glass
Percy F. Wolfe,

Inventor:

Frank M. Clark,
by his attorney, Charles S. Goring.

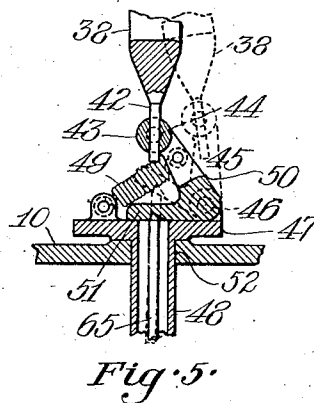
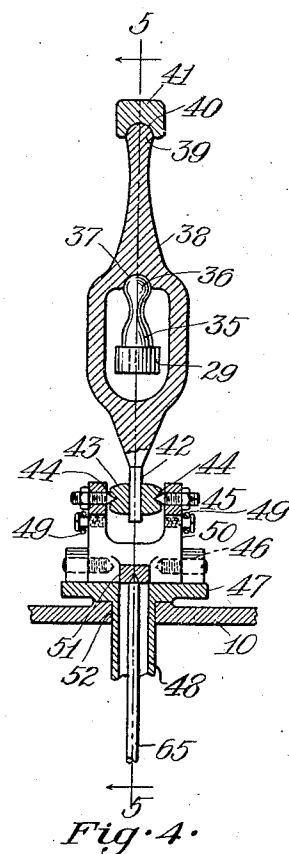
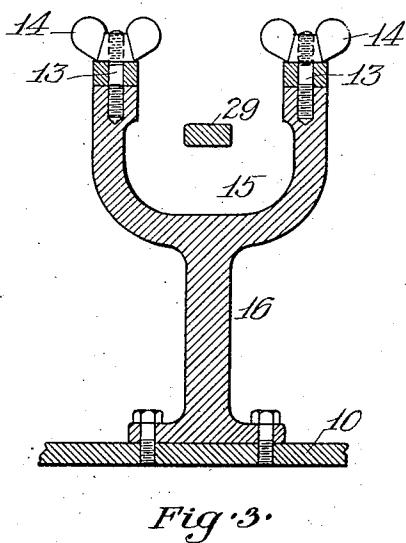
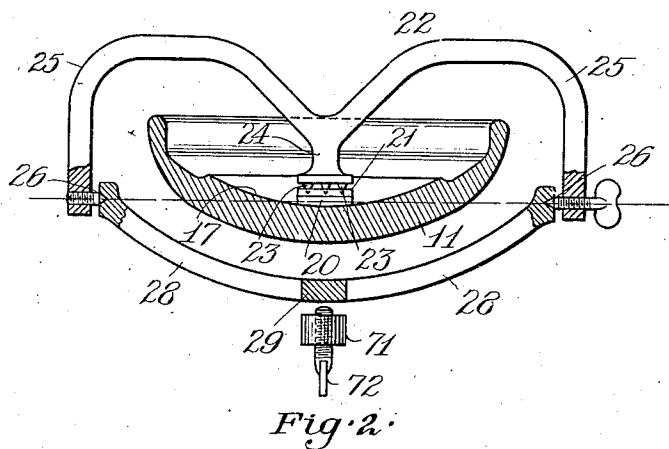
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3 SHEETS—SHEET 2.



Witnesses:

William C. Glass,
Percy S. Wolfe.

Inventor:

Frank M. Clark,
by his attorney, Charles S. Goring.

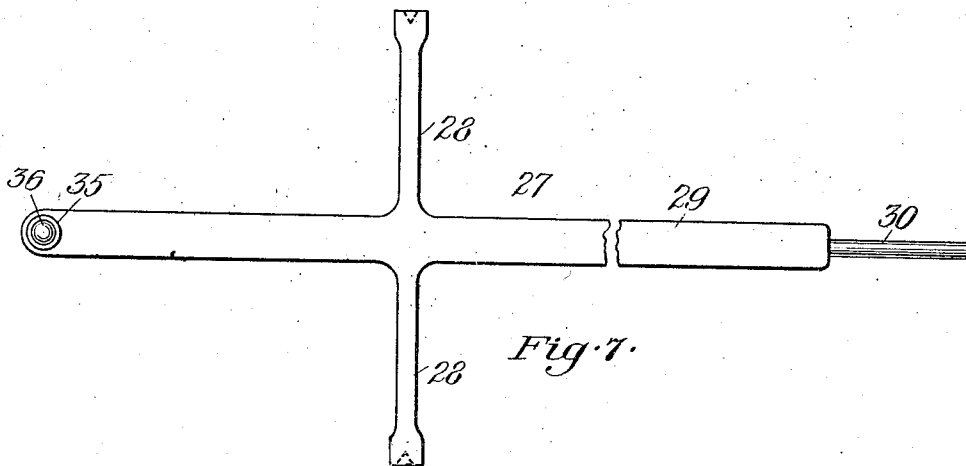
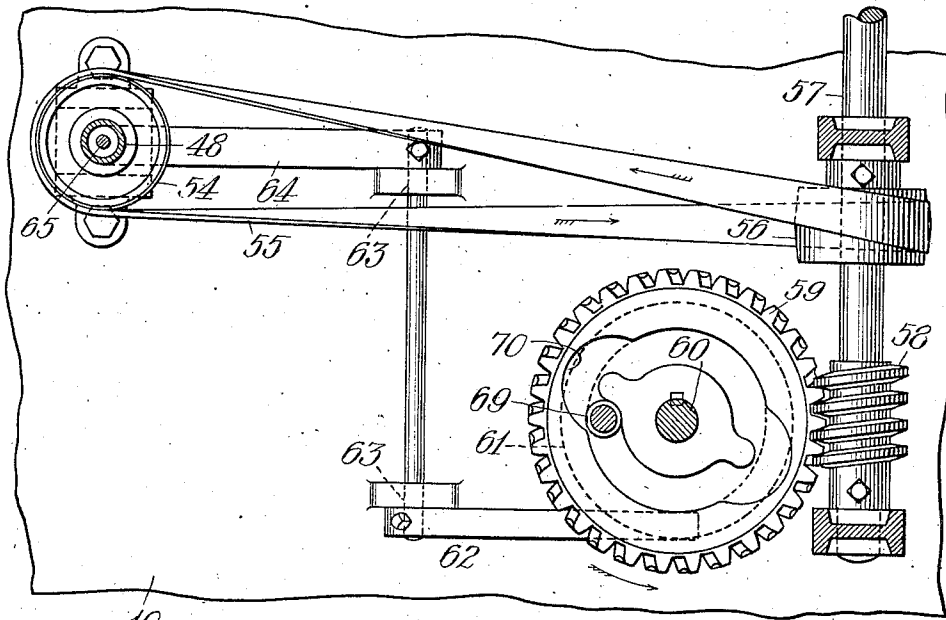
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3 SHEETS—SHEET 3.



Witnesses:

William C. Glass.
Percy S. Wolfe.

Inventor:

Fred M. Clark,
by his attorney, Charles S. Gordon.

UNITED STATES PATENT OFFICE.

FRANK M. CLARK, OF TILTON, NEW HAMPSHIRE, ASSIGNOR OF ONE-THIRD
TO CHARLES H. PHILBRICK, OF TILTON, NEW HAMPSHIRE, AND ONE-
THIRD TO FRANK G. BALCOM, OF MEDFORD, MASSACHUSETTS.

MACHINE FOR GRINDING LENSES.

No. 857,791.

Specification of Letters Patent.

Patented June 25, 1907.

Application filed March 19, 1906. Serial No. 306,722.

To all whom it may concern:

Be it known that I, FRANK M. CLARK, a citizen of the United States, residing at Tilton, in the county of Belknap and State of New Hampshire, have invented new and useful Improvements in Machines for Grinding Lenses, of which the following is a specification.

This invention relates to machines for grinding lenses, and the machine of this invention is particularly adapted for grinding toric and bi-focal lenses, the same being an improvement upon Letters Patent No. 761,207, granted to me May 31, 1904.

In grinding lenses it is my practice to move the same about a metal form in which is a solution of grinding material mixed with water, the whole constituting a grinder. Sometimes the lenses are kept flooded with a thin solution of grinding material to which small quantities of said grinding solution are added at short intervals. The ordinary substantially flat lens can be made to move about on the grinder or "lap" in large curvilinear movements which admit of a large sweep or stroke, so that the grinding material has no difficulty in getting under all parts of the lens, but in the classes of lenses known as "toric" and "bi-focal," where the radius of curvature is very short, the grinding movement of the lens is necessarily confined in its scope almost entirely to one meridian, but as the grinding motion should be as near circular as possible, in order that it may grind as readily in one meridian as another, it is obvious that the throw given to the grinding of a toric lens is exceedingly short. The same is also true in the grinding of invisible bi-focal lenses, where two distinct surfaces must be ground on the same side of the lens, the throw of the grinding motion in this latter case being made even shorter than that used in grinding toric lenses. The objection to, or difficulty found in, grinding with a short motion is that certain portions of the "laps" or grinders are never uncovered, but are continually under the lenses which are being ground, so that they are never exposed directly to the flooding of the grinding material.

As a result of a very extended practical experience in the grinding of lenses with a short curvilinear motion, I have found that it is

impossible to produce a surface free from distortion and waves which shall correspond exactly with the surface of the "lap" or grinder. I have found, however, that by frequently raising the lens for an instant from the bed of the "lap" and allowing the grinding solution to pass under said lens and fill the partial vacuum that otherwise would be formed, I can produce perfect toric surfaces free from said distortions and waves. This lifting of the lens away from the grinder or "lap" allows the grinding material to pass in under the lens and wash out a thin layer of partially worn out grinding material as well as the glass which has been ground from the lens, after which the lens is returned to its seat. A fresh supply of grinding material on all parts of the surface of the lens has thus been supplied. In practice, twelve or fifteen rotations brings the glass, even when subjected to a light pressure, dangerously near the metallic surface of the "lap," so that the machine of this invention is so designed as to automatically move the lens away from the "lap" at the end of about every fifteen rotations or curvilinear movements of the lens.

While I have in the following specification shown and described the mechanism as adapted to move the lens away from the grinder, it is evident that the grinder may be moved away from the lens with equally good results without departing from the spirit of my invention. In the latter case it will be understood that the lens is made stationary and the grinder is given a curvilinear movement and also an intermittent movement away from the lens. It will also be understood that while I have in the following specification and in the drawings illustrated my invention as particularly applied to grinding toric lenses, the function performed by said machine of moving the lens away from the grinding surface at certain intervals may be applied with equally good results to other forms of lens grinding machinery in so far as this particular function of the machine is concerned, so that the lens and "lap" may be separated one from the other at frequent intervals and allow the grinding mixture to flow between the "lap" and the surface of the lens which is being ground thereon.

The invention consists in a machine for grinding lenses of a grinder or "lap," a

holder adapted to hold a lens in contact with said grinder, mechanism to impart to one of said parts a curvilinear motion relatively to the other, and mechanism to move one of said parts away from the other, whereby said lens is moved out of contact with said grinder, the grinder, as a whole, in this connection being represented by the metal "lap" together with the grinding material contained therein, as the lens is never intended to be brought into direct contact with the metal which forms the "lap," but is intended at all times to be separated from said metal by a layer of grinding material, which layer, together with the "lap" constitutes a grinder in the sense in which it is used in the following specification and in the claims.

The invention further consists in the combination and arrangement of parts set forth in the following specification and particularly pointed out in the claims thereof.

Referring to the drawings: Figure 1 is a side elevation of my improved lens grinding machine, partly broken away and shown in section, the link which forms one support of the carrier, together with the bell-crank lever connected to said link, being shown in dotted lines in a second position. Fig. 2 is a section, partly in elevation, taken on line 2—2 of Fig. 1, looking toward the right in said figure. Fig. 3 is a section, partly in elevation, taken on line 3—3 of Fig. 1. Fig. 4 is a section, partly in elevation, taken on line 4—4 of Fig. 1. Fig. 5 is a section, partly in elevation, taken on line 5—5, Fig. 4, the same being shown in dotted lines in a second position. Fig. 6 is a section, partly in elevation, taken on line 6—6 of Fig. 1. Fig. 7 is a plan view of the carrier.

Like numerals refer to like parts throughout the several views of the drawings.

In the drawings, 10 is the frame of my improved lens grinding machine which may be of any suitable construction and shape. 11 is a stationary grinder, preferably constructed of cast iron and known as a "lap," in which the grinding solution is contained. Said grinder is rigidly fastened to a bracket 12 which is fastened by screws 13 and thumb-nuts 14 to the U-shaped top 15 of a standard 16 forming a portion of the frame 10. By unscrewing the nuts 14, the grinder or "lap" may be readily removed from the machine. Said grinder 11 has a concave inner surface 17 corresponding to the convex form which it is desired to impart to the lens to be ground.

In order to impart the desired form to the lens to be ground, it will be seen that the mechanism by which the lens is passed over said surface 17 during the grinding operation, as hereinafter described, must yield and conform itself to the different positions of said lens, so that the lens as it is pressed against and moved around over said concave

surface 17 in a series of curves will not tip up on its edges, but will be subjected to a constant and even pressure.

The lens 20 is fastened to a plate 21, which plate is maintained in a fixed relation to a holder 22 by pins 23 fast to said holder and projecting into said plate. The holder 22 is shown in detail in Fig. 2 and consists of a central portion 24 and two curved side arms 25, 25. Said side arms are pivoted by means of the two sharp pointed centers 26, 26 to a carrier 27. It will be noted that the median pivotal line passing through the center of the pivots 26 intersects the portion of said grinding surface with which said lens is in contact.

The carrier 27 is illustrated in detail in Fig. 7 and is formed in the shape of a cross, the transverse arms 28, 28 of which are curved upwardly (Fig. 2) to receive the pivotal pins or centers 26 upon which the holder 22 rocks. The body portion 29 of the carrier extends longitudinally of the machine beneath the holder 22 and grinder 11 and has a cylindrical portion 30 at its rear end which passes through a hole 31 in a rocker-arm 32. The hole 31 is rounded or beveled at its opposite ends in order to allow the carrier, or the cylindrical portion 30 thereof to rock in said holder as well as to allow said cylindrical portion to slide longitudinally therein. The rocker-arm 32 is pivoted at 33 to the standard 16 and is held downwardly by the tension of a spring 34, one end of which is fastened to said rocker-arm and the other to the frame 10.

In the front end of the carrier 27 is fastened a stud 35, the upper end 36 of which is made spherical in form (Figs. 1 and 4) to engage a corresponding recess 37 formed in the link 38. Said link is also made spherical in form at its upper end at 39, said spherical end engaging a corresponding recess 40 formed in the under side of a bracket 41, said bracket being rigidly fastened to the frame 10 of the machine. The lower end of the link 38 is of cylindrical form at 42 and this cylindrical portion extends through a hole formed in a block 43 pivoted to rock at 44 in a bell-crank lever 45. The bell-crank lever 45 is pivoted at 46 to the top of a face plate 47 formed upon the upper end of a vertical shaft 48. Springs 49 hold the bell-crank lever normally in the position illustrated in Figs. 1 and 5. The bell-crank lever 45 consists of a bifurcated arm 50 to which the block 43 is directly pivoted and of an arm 51.

The vertical shaft 48 is journaled to rotate in bearings 52, 53 formed in the frame 10. Said shaft is rotated by means of a pulley 54 connected by a belt 55 to a pulley 56 fast to the main driving shaft 57, said main driving shaft being journaled to rotate in bearings formed in the frame 10, and driven by any suitable power. Said main driving shaft 57 has a worm 58 fast thereto which meshes into a worm-gear 59 fast to a vertical shaft 60

journalled to rotate in bearings formed in the frame 10. Upon the under side of the worm gear 59 is a cam 61 having a serpentine path in engagement with a lever 62. The lever 62 is pivoted at 63 to the frame 10 and the outer end of the left hand arm 64 of said lever engages the lower end of a vertical rod 65 which passes upwardly through the center of the hollow shaft 48 and at its upper end engages the arm 51 of the bell-crank lever 45.

Another bell-crank lever 66 is pivoted at 67 to an ear upon the standard 16. One arm 68 of said bell-crank lever has a cam-roll 69 journalled thereon which engages a cam 70 formed in the worm gear 59. The other arm 71 of said bell-crank lever has a thumb-screw 72 in engagement therewith located beneath the carrier 27 and substantially beneath the center of the grinder 11. It will be noted that a line passing through the center of the spherical end 36 of the stud 35 and intersecting the median line of the pivotal centers 26, 26, when prolonged will coincide with the median line of the cylindrical portion 30 of the carrier 27 within the bearing formed by the hole 31.

The general operation of the mechanism hereinbefore described is as follows: The lens 20 is attached to the plate 21 by means of tar and resin and is moved about in a series of curves over the concave surface 17 of the grinder 11. Water and emery in the proper proportions are poured into the grinder 11 from time to time. The curvilinear motions imparted to the lens 20, in order to pass the same over the surface of the grinder, are imparted thereto by means of the carrier 27, it being understood that the holder 22 is pivotally supported on the pivotal centers 26 of said carriers and that the carrier itself is pivoted at its opposite ends to the rocker-arm 32 at its rear end and to the link 38 at its front end. When the parts are in the position illustrated in Fig. 1, there will be no motion imparted to the carrier or to the lens and its supporting holder by the rotation of the hollow shaft 48, but as the main shaft 57 is rotated it imparts, by means of the worm 58, a rotary motion to the worm-gear 59 and to the shaft 60 to which said worm gear is fastened. This rotary motion is also imparted to the cam 61, whereby the lever 62 is rocked upon its pivot 63, the right hand end of said lever being depressed by the serpentine form of the cam 61, thus raising the arm 64 of said lever, pushing the vertical rod 65 upwardly within the hollow shaft 48, and tipping the bell-crank lever 45 from the position shown in full lines (Fig. 5) to the position shown in dotted lines therein. Before this tilting of the bell-crank lever takes place the median axial line of the hollow shaft 48 and the longitudinal median line of the link 38 are in alinement with each other, but after the tipping of the bell-crank lever

45 to the position illustrated in dotted lines (Figs. 1 and 5) said median lines will not be in alinement and the spherical end 36 of the stud 35 will be moved out of alinement with the median axial line of the shaft 48, so that said shaft, as it is rotated, will impart a circular movement to the spherical end of the stud 35, and thus, through the carrier 27, and the holder 22, the lens 20 will be moved in a series of curvilinear paths around over the concave surface of the grinder.

It will be seen that when the link 38 and bell-crank lever 45 are moved from the position shown in full lines (Fig. 1) toward that shown in dotted lines in said figure, or, in other words, when the spherical end 36 of the stud 35 is moved out of alinement with the median axial line of the vertical shaft 48, said link 38 and bell-crank lever 45 constitute together a crank relatively to said shaft 48 and are rotated thereby to impart the motion hereinbefore described to the carrier 27. It will also be noted that the crank thus formed is of constantly varying throw, the length of throw of said crank depending upon the distance of the center of the spherical end 36 of the stud 35 from the median axial line of the shaft 48 prolonged, and this distance is determined by the position occupied by the lever 62.

As hereinbefore set forth, when the lever 62 is in the position illustrated in Fig. 1, the center of the spherical portion 36 of the stud 35 is in alinement with the median axial line of the shaft 48 and there is no circular movement at this time imparted to the lens, so that it is when the parts are in this particular position that the lens should be removed from contact with the grinder. This movement of the lens upwardly, together with the holder 22 and the carrier 27, is accomplished by the bell-crank lever 66 which is rocked upon its pivot by the cam 70, bringing the thumb-screw 72 into contact with the under side of the carrier 27 and rocking said carrier upwardly upon the spherical end 36 of the stud 35 as a pivot until the lens 20 is moved away from the grinder 11 a sufficient distance to allow the grinding material to flow in between the lens and the concave inner surface 17 of said grinder, whereupon the cam releases the lever 66 and the lens is brought back in position to be still further ground by being moved over the surface of the grinder in a series of curvilinear motions.

When the carrier 27 is tipped upon its pivot, as just described, the rear end of said carrier moves upwardly, the rocker-arm 32 tipping upon its pivot and the spring 34 yielding in order that said carrier may thus be moved. When the carrier is released, the spring 34 moves the rear end thereof downwardly, thus carrying the lens into contact with the grinder through the pivoted holder to which said lens is fastened. After the

lens is finished it may be readily detached by removing the holder 22 from the machine by unscrewing the center 26 at the right (Fig. 2) and then slipping the holder, together with the lens, off the other center 26 at the left of Fig. 2. While I have described the median center line of the pivot 26 as intersecting a line connecting the pivotal points of the carrier 27, said median center line may be moved slightly, say 116" above or below said line without interfering materially with the operation of the machine or detracting from the quality of the work produced thereby, and I, therefore, do not wish to limit my invention to a machine constructed with the connecting line drawn between the pivotal points of said carrier exactly intersecting the median center line of the pivots whereby the lens holder is pivoted to said carrier.

As there are two throws on the cam 70, it will be seen that the lens will be lifted away from the grinder twice for each rotation of the worm 58, and further it will be understood that by varying the depth of the convolutions of the cam 61 a variation will be obtained in the throw of the crank-arm, thus imparting a differential motion to the lens relatively to the grinding surface of the grinder 11, and, thus, if desired, variation in the curvilinear motions of the lens over the surface of the grinder may be obtained.

In practice I have found it desirable to form the serpentine path of the cam 61 with three depressions therein of less depth than the depression 61' with which the lever 62 is in engagement (Fig. 1), these depressions occurring between each of the depressions of the same depth as the depression 61', so that the arm of the lever 62, after passing out of one of the deep depressions 61' will be moved up and down a less extent, so that the link 38 will not be brought back to a central position coincident with the median axial line of the shaft 48 until said lever can drop into one of the depressions 61'. These intermediate depressions 61², 61³ may be of different depths in order to provide a differential motion to the grinding of the lens.

Having thus described my invention, what I claim and desire by Letters Patent to secure is:

1. A machine for grinding the surface of a lens comprising in its construction a grinder, a lens holder adapted to hold said lens in contact with said grinder, mechanism to impart to one of said parts a curvilinear motion relatively to the other about an axis substantially at right angles to said surface, and mechanism to move one of said parts away from the other, whereby said lens is moved out of contact with said grinder.

2. A machine for grinding the surface of a lens comprising in its construction a grinder, a lens holder adapted to hold said lens in contact with said grinder, mechanism to impart

to one of said parts a curvilinear motion relatively to the other about an axis substantially at right angles to said surface, mechanism to rock one of said parts about an axis extending transversely of said lens, and mechanism to move one of said parts away from the other, whereby said lens is moved out of contact with said grinder.

3. In a machine for grinding lenses a rocker-arm, a rotary crank, a carrier constituting a link, one end thereof pivoted to said rocker-arm the other to said crank, a holder for a lens pivoted to said carrier, a stationary grinder against which the surface of said lens is adapted to be pressed, and mechanism to move said holder toward and away from said grinder.

4. In a machine for grinding lenses, a rocker-arm, a rotary crank, a carrier constituting a link, one end thereof pivoted to said rocker-arm the other to said crank, a holder for a lens pivoted to said carrier, a stationary grinder against which the surface of said lens is adapted to be pressed, means to press said lens against said grinder, and mechanism to move said holder toward and away from said grinder.

5. A machine for grinding lenses comprising in its construction a carrier, a holder for a lens pivotally supported upon said carrier, a stationary grinder, means to press said lens against said grinder, mechanism pivotally connected to said carrier, whereby said holder is moved in a curvilinear path over the surface of said grinder, the median pivotal line of said holder extending transversely of and intersecting a portion of said grinding surface, and mechanism to move said holder toward and away from said grinder.

6. A machine for grinding lenses comprising in its construction a rocker-arm, a carrier pivoted thereto, a grinder, a holder for a lens pivoted to said carrier, and means to press said lens against the surface of said grinder with a spring pressure; in combination with mechanism constructed to impart a curvilinear motion to one end of said carrier, whereby said lens is carried in a curvilinear path over the surface of said grinder, and mechanism to move said holder toward and away from said grinder.

7. A machine for grinding lenses comprising in its construction a grinder having a curved grinding surface, a pivotally supported carrier, a holder for a lens pivoted to said carrier and adapted to hold said lens against said curved grinding surface, the median pivotal line of said holder extending transversely of and intersecting a portion of said grinding surface, and mechanism to move said holder toward and away from said grinder.

8. A machine for grinding lenses comprising in its construction a grinder having a curved grinding surface, a carrier constituting a link, one of the pivots of said link lo-

ated above, the other below, said grinding surface, a holder for the lens pivoted to said carrier and adapted to hold said lens against said grinding surface, the median pivotal line of said holder extending transversely of and intersecting a portion of said grinding surface, and mechanism to move said holder toward and away from said grinder.

9. A machine for grinding lenses comprising in its construction a stationary grinder, a lens holder adapted to hold a lens in contact with said grinder, mechanism to impart to said lens holder a curvilinear motion relatively to said grinder, and mechanism to move said lens holder away from said grinder, whereby said lens is moved out of contact with said grinder.

10. In a machine for grinding lenses, a rocker-arm, a rotary crank, a carrier, one end pivotally and slidably supported upon said rocker-arm, the other end pivoted to said crank, a holder for a lens pivoted to said carrier, and a stationary grinder against which the surface of said lens is adapted to be pressed.

11. In a machine for grinding lenses, a rocker-arm, a rotary crank, a carrier, one end pivotally and slidably supported upon said rocker-arm, the other end pivoted to said crank, a holder for a lens pivoted to said carrier, a stationary grinder against which the surface of said lens is adapted to be pressed, and mechanism to move said holder toward and away from said grinder.

12. A machine for grinding lenses comprising in its construction a grinder, a holder for a lens, a carrier to which said holder is pivoted, a rocker-arm upon which one end of said carrier is pivotally supported, a rotary shaft, a second rocker-arm pivoted to one

end of said shaft, and a link one end pivotally supported on said last named rocker-arm, the other end pivoted to the frame of said machine, said carrier pivotally supported at one end thereof upon said link.

13. A machine for grinding lenses comprising in its construction a grinder, a holder for a lens, a carrier to which said holder is pivoted, a rocker-arm upon which one end of said carrier is pivotally supported, a rotary shaft, a second rocker-arm pivoted to one end of said shaft, a link one end pivotally supported on said last named rocker-arm, the other end pivoted to the frame of said machine, said carrier pivotally supported at one end thereof upon said link, and mechanism to rock said last named rocker-arm and link, whereby one pivotal center of said carrier is moved into and out of alinement with the median axial line of said shaft.

14. A machine for grinding lenses comprising in its construction a grinder, a holder for a lens, a carrier to which said holder is pivoted, a rocker-arm upon which one end of said carrier is pivotally supported, a rotary shaft, a second rocker-arm pivoted to one end of said shaft, a link one end pivotally supported on said last named rocker-arm, the other end pivoted to the frame of said machine, said carrier pivotally supported at one end thereof upon said link, and mechanism to move said holder toward and away from said grinder.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FRANK M. CLARK.

Witnesses:

WILLIAM B. FELLOWS.

HALAM F. GILES.