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Larson et al.

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[45] **Dec. 10, 1974**

[54] **APPARATUS FOR FORMING PROGRESSIVE POWER LENS BLANKS**

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[21] Appl. No.: **335,256**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 284,098, Aug. 28, 1972, abandoned.

[52] **U.S. Cl.** ..... **51/33 R,** 51/73 R, 51/284

[51] **Int. Cl.** **B24b 13/04**

[58] **Field of Search** .....51/33 R, 73 R, 96, 99, 51/100 R, 1242, 284

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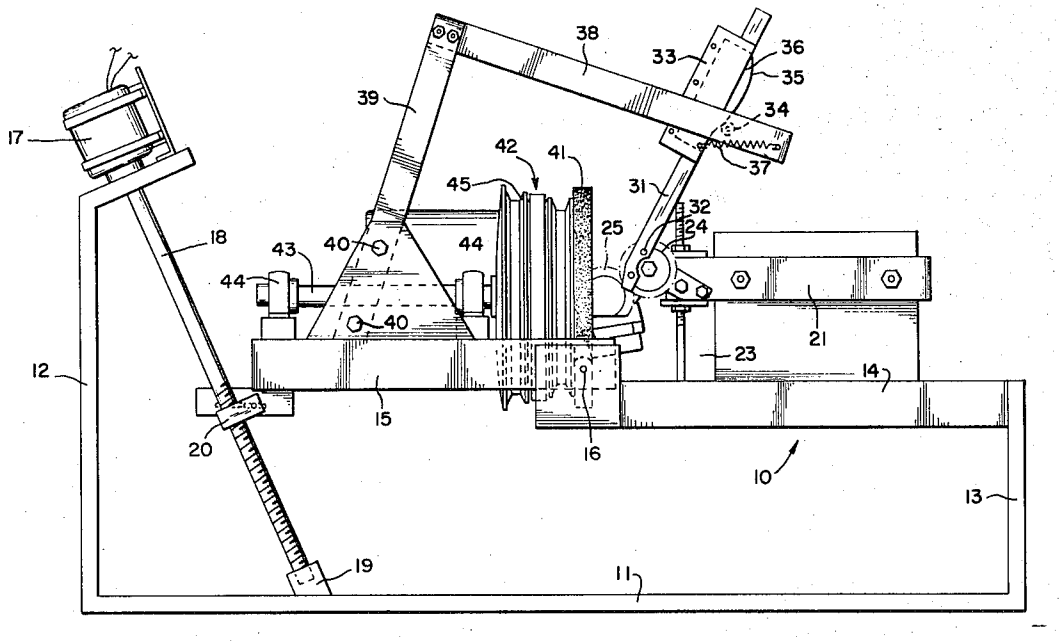
Assistant Examiner—Nicholas P. Godici
Attorney, Agent, or Firm—Wilkinson, Mawhinney & Theibault

[57] **ABSTRACT**

The present disclosure is directed to a machine and method for grinding lens blanks of progressive power in which an annular abrasive grinding ring having its internal diameter radiused is mounted for pivotal movement relative to a static frame which supports a gear driven pivotally linked lens carrier which is connected to be rocked proportional to the relative movement between the grinding ring and static frame to provide a progressive power lens measured from its bottom to top or vice versa.

6 Claims, 14 Drawing Figures



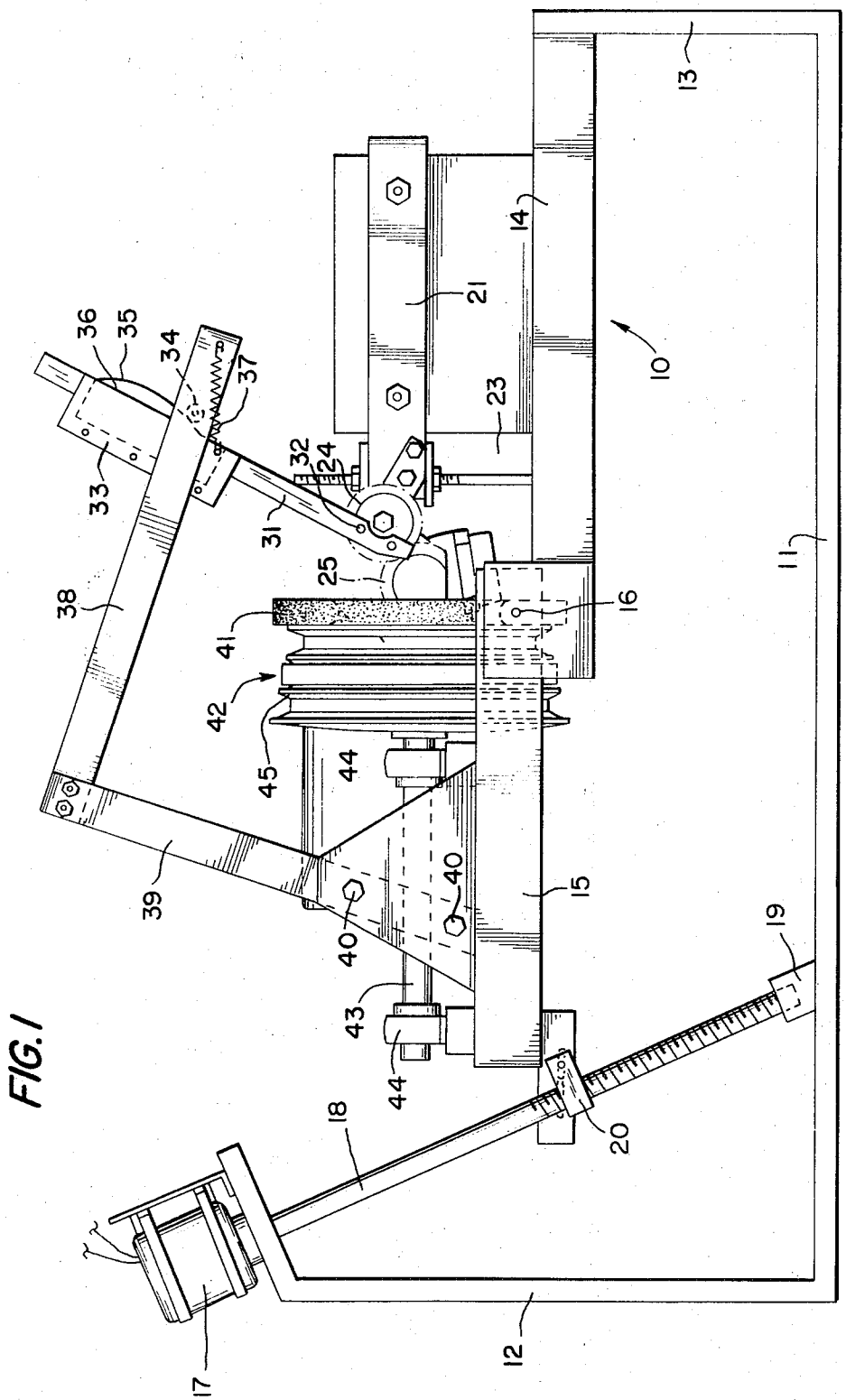

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FIG. 1

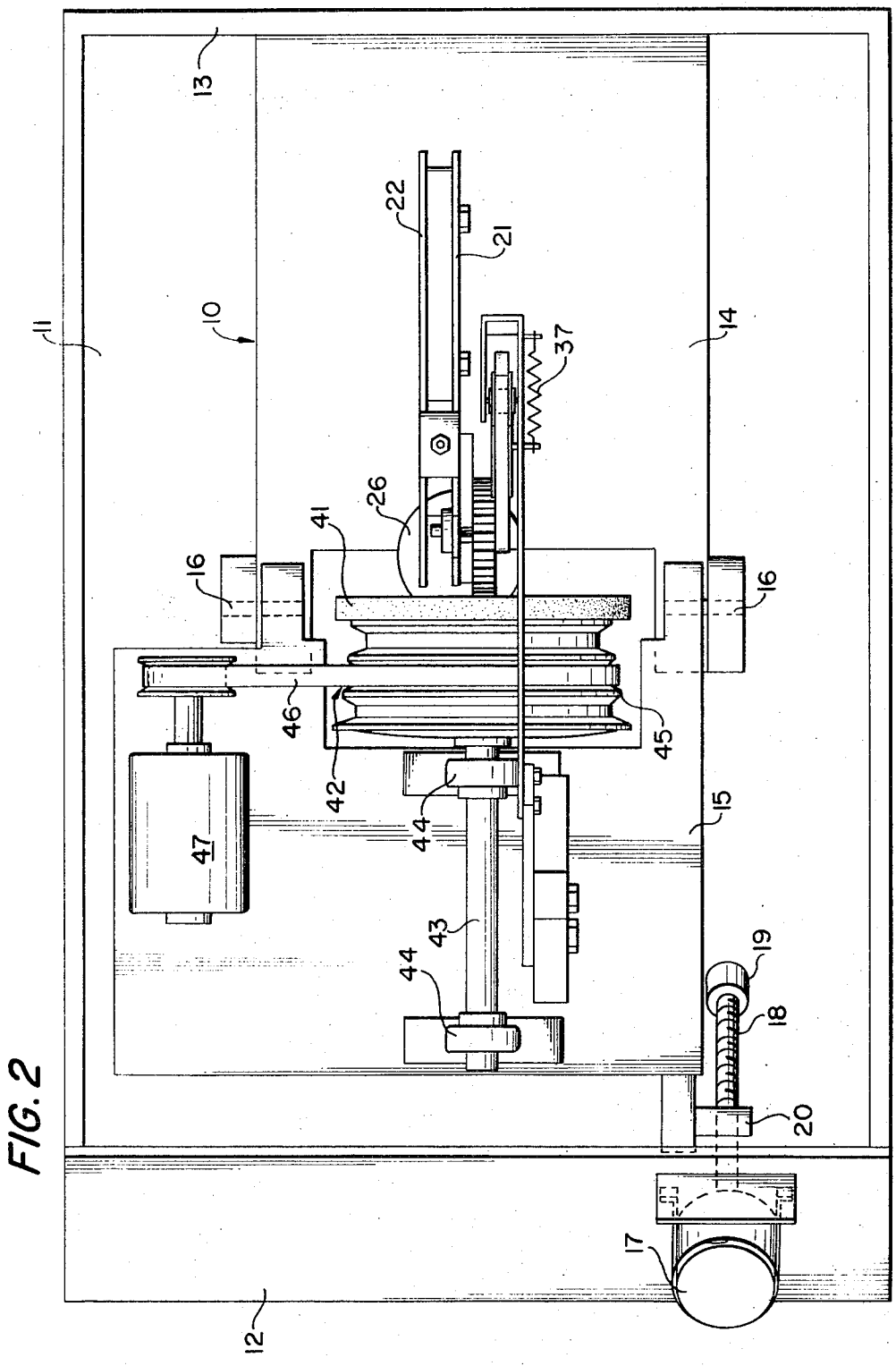


FIG. 2

FIG. 3

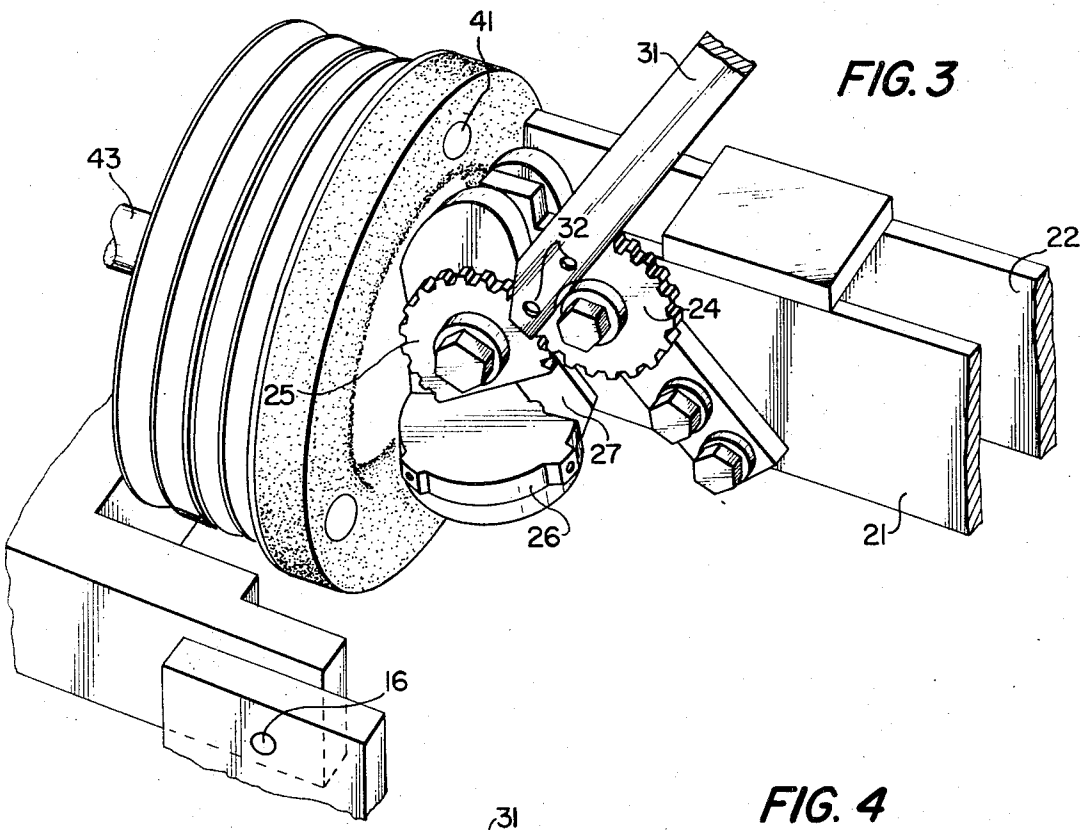
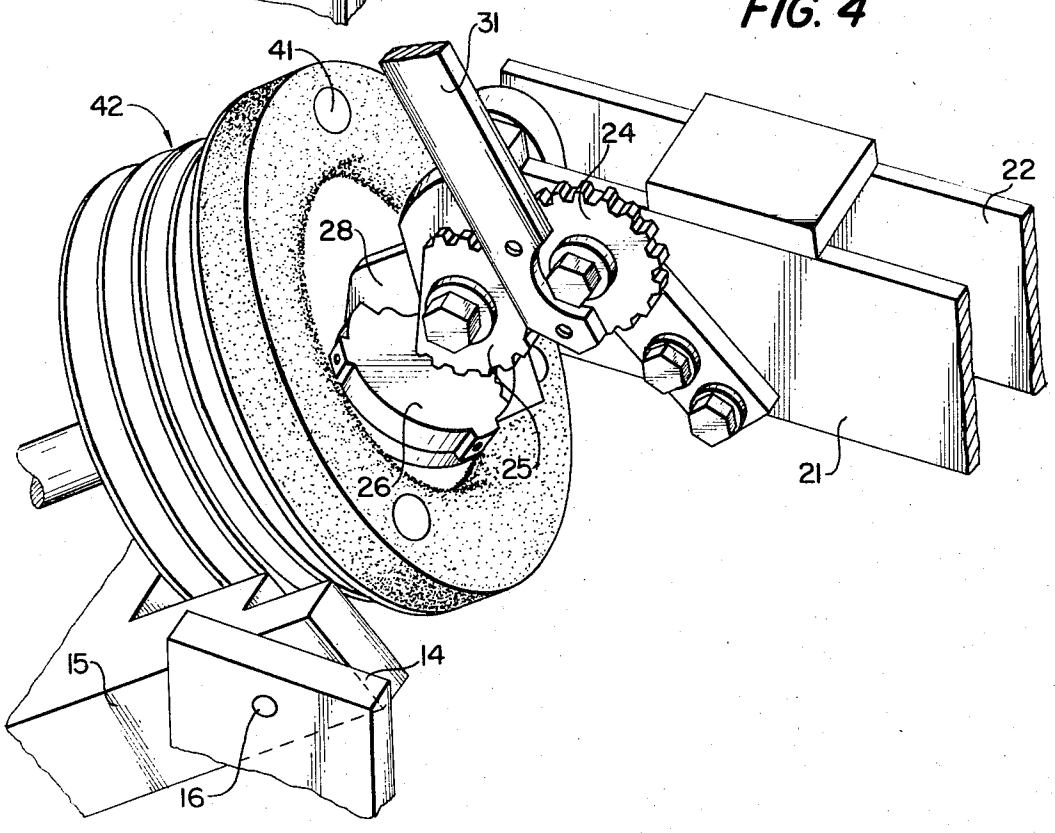


FIG. 4



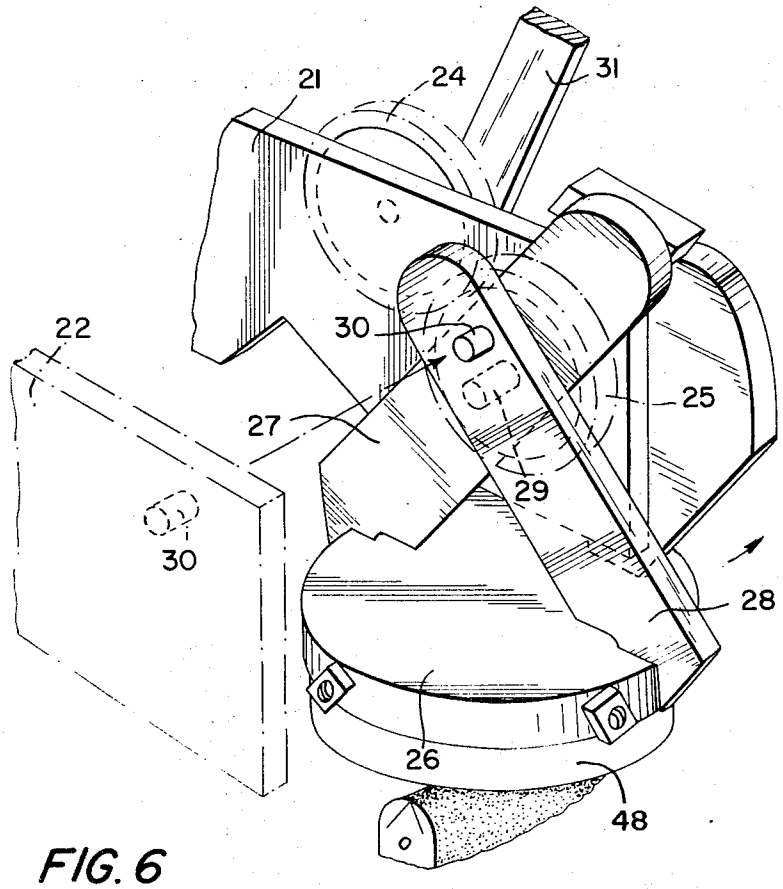
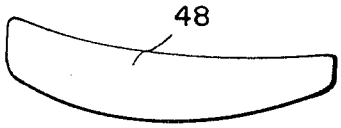


FIG. 5

FIG. 6



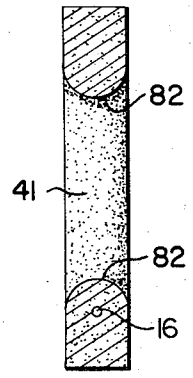


FIG. 7

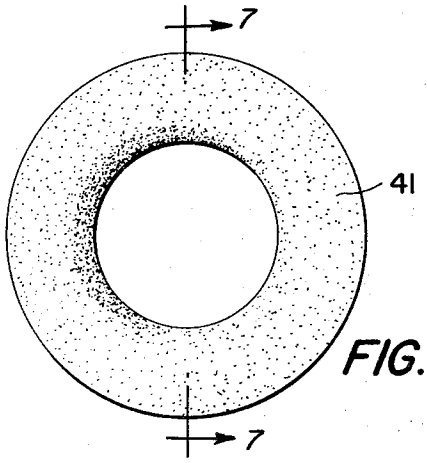


FIG. 8

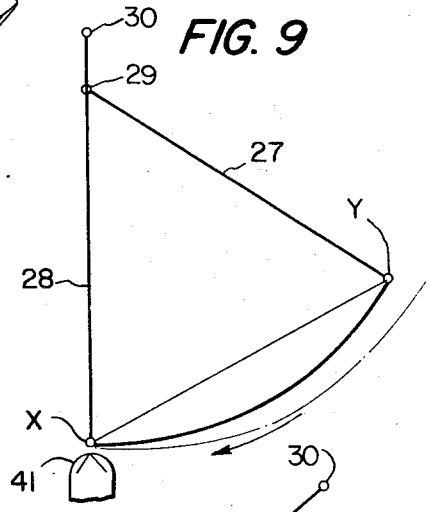


FIG. 9

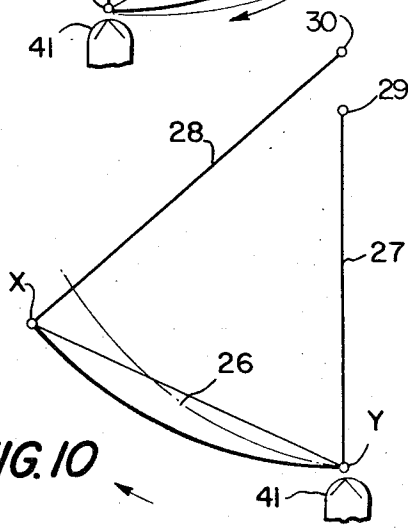


FIG. 10

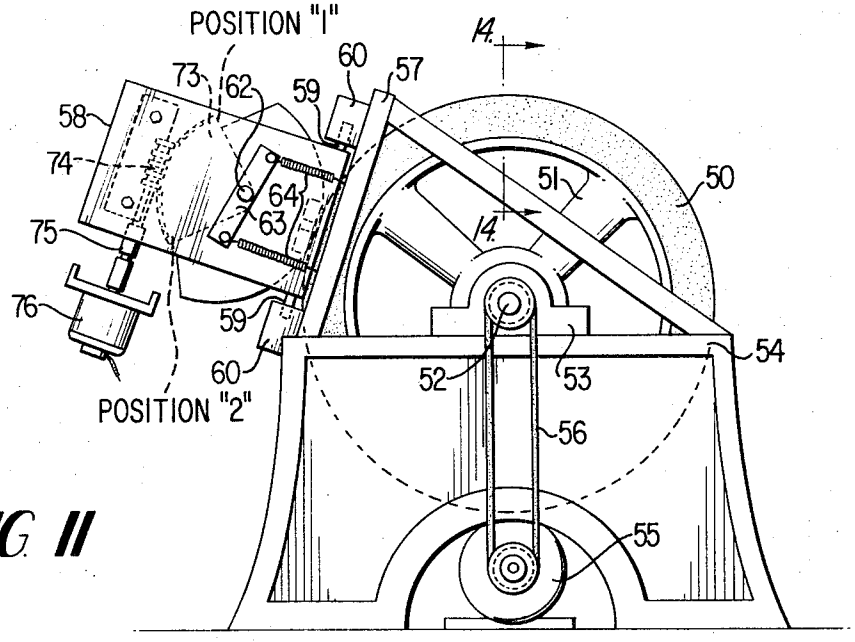


FIG. 11

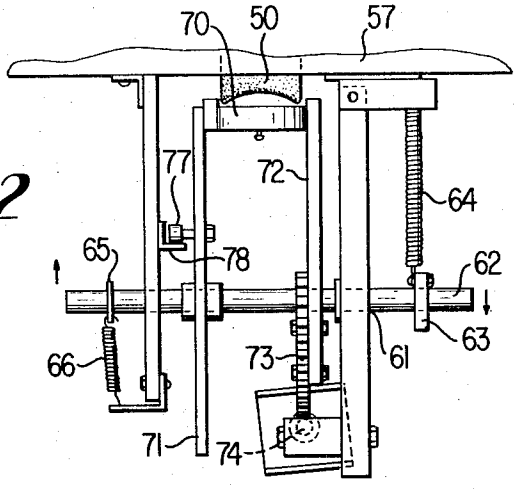


FIG. 12

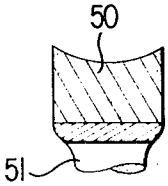


FIG. 14

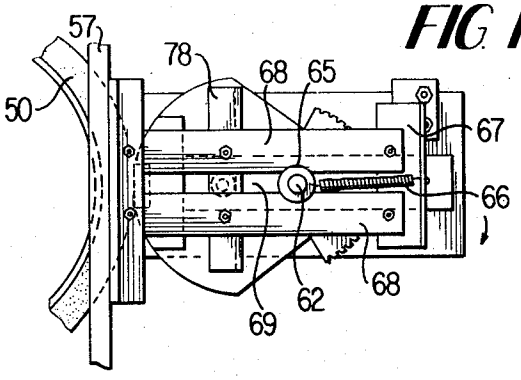


FIG. 13

APPARATUS FOR FORMING PROGRESSIVE POWER LENS BLANKS

This application is a continuation-in-part of application Ser. No. 284,098, filed Aug. 28, 1972 and now abandoned.

An object of the present invention is to provide a machine and method for forming a lens with a progressive power from the top of the lens to the bottom which must have the horizontal radii gradually decreased from the top of the lens to the bottom, or conversely, increased from the bottom to the top. The horizontal curves must be straight across the lens from side to side. In the vertical meridian there must be a gradually changing curve similar to an involute curve. However, the change in the vertical curve must always coincide with the change in the horizontal curve that is the radii of the horizontal curves must intersect with the same radius of the vertical curve. The most accurate way to measure this is with a lens measure, commonly called a lens clock.

If the clock is held against the lens with the pins horizontal and moved downward, it will show a gradual increase in power. When the clock is held with the pins vertical, and moved downward it will also show a gradual increase in power. When the clock is held vertical and moved laterally to the edges, it should show no deviation. If the clock is rotated with the center pin remaining on one point, it should clock the same as a sphere (i.e., no movement of the needle).

A further object of the present invention is the provision of a machine which employs a rotary abrasive ring which ring has its internal diameter radiused and which ring is pivoted at the radius for movement of the abrasive ring about a pivot on the static frame to provide a relative rocking motion between a first static frame on which the rotary abrasive ring is mounted for rotation and the static frame. The static frame has mounted thereon a gear driven lens carrier which is pivotally linked to the static frame and the gears in mesh to cause the links to rock the lens carrier relative to a signal to motion of one of the gears which is connected to be driven by the movable frame.

A still further object of the present invention is to provide a machine as described above with a template control for varying the rate of cut incident to the movement of the pivoted arms of the lens carrier and the rocking of one of the gears to drive the arms to either increase or decrease the wiping action of the lens carrier and the lens supported thereon during grinding during passage of the lens through the annular ring abrasive which is grinding the lens blank.

A still further object of the present invention is to provide a machine which employs a rotary abrasive ring the cross section of the periphery of which has the contour of the lens being ground and which cooperates with a lens carrier which is mounted to partake of both vertical and horizontal vectors at right angles to one another which subjects the lens being ground to both a grinding and wiping action.

A lens blank constructed in accordance with the present invention may have prescriptions ground therein and the lens blank itself will vary in thickness from the top to the bottom so that bi-focals are not necessary in the lens construction.

With the foregoing and other objects in view the invention will be more fully described hereinafter and more particularly pointed out in the appended claims.

In the drawings in which like parts are denoted by reference characters throughout the several views:

FIG. 1 is a side elevational view of a machine constructed in accordance with the present invention.

FIG. 2 is a top plan view of the machine of FIG. 1.

FIG. 3 is a perspective view of the lens carrier and abrasive annular grinding ring with the lens carrier in the initial or beginning grinding position.

FIG. 4 is a view similar to FIG. 3 with the lens grinding ring tilted to its maximum grinding position and the lens carrier having been advanced through the internal opening of the grinding ring to its maximum position.

FIG. 5 is a perspective view of the linkage for supporting the lens carrier showing its driving connection with the gear drive and the movable frame.

FIG. 6 is a cross sectional view of a lens blank ground in accordance with the method of the present invention.

FIG. 7 is a vertical section taken through the annular grinding abrasive employed with the movable frame of the present invention.

FIG. 8 is a front elevational view of the annular grinding abrasive ring of FIG. 7.

FIGS. 9 and 10 are diagrammatic views of the position of the lens holder at the beginning and end of the grinding step.

FIG. 11 is a side elevational view of a modified form of lens grinding machine constructed in accordance with the present invention.

FIG. 12 is a top plan view of the lens holder and its support mechanism for the form of machine shown in FIG. 11.

FIG. 13 is a left side elevational view of the lens holder of FIG. 12.

FIG. 14 is a section taken through the grinding abrasive wheel on the line 14—14 of FIG. 11.

Referring now to FIGS. 1 and 2, 10 designates generally the static frame having a base 11 and ends 12, 13. Above the base 11 is a work table 14 to which a movable frame 15 is pivoted at 16. The upper portion of end 12 supports a motor 17 which drives a screw shaft 18 journalled in bearing 19.

The movable frame 15 has secured thereto a screw follower 20 which meshes with the threads of screw shaft 18 so that upon rotation of the shaft 18 the movable frame 15 will pivot about its axis of pivot 16.

Secured to the work table 14 are plates 21, 22 mounted on a support 23 rigid with the work table 14.

Referring now to FIGS. 3, 4 and 5 a pair of gears 24 and 25 are mounted for rotation on plate 21. A lens carrier 26 has a pair of arms 27, 28 pivotally connected thereto. The arm 28 is longer than the arm 27 and is pivoted to plate 21 at 29, while arm 27 is pivoted to plate 22 at 30. The hub of gear 24 causes shaft 29 to rotate causing the long arm 28 to swing the lens carrier 26 as shown by the arrow in FIG. 5 from the position shown in FIG. 3 to that of FIG. 4. Gear 24 is caused to rotate by arm 31 which is secured thereto at 32. The arm 31 is connected through a template receiver 33, cam roller 34 which follows the cam surface 35 on a cam 36 in the cam template receiver 33 under the influence of spring 37. The cam receiver 33 is carried by

arms 38, 39 which are secured to the movable frame 15 at 40.

As best seen in FIG. 2 the movable frame 15 has mounted thereon an annular ring like member of abrasive material 41, the internal diameter of which is radiused at 82, which radius defines the pivot point of the movable frame 14 at 16. The annular ring like abrasive ring 41 is mounted for rotation on a head 42, having a shaft 43 mounted in bearings 44. Pulleys 45 which drive the shaft 43 and ring 41 are driven by belts 46 from a motor 47 mounted on the movable frame 15.

As shown in FIG. 6 the lens blank 48 after being ground has a variable thickness from top to bottom, or left to right. The lens blank is secured to the lens carrier 26 in accordance with conventional practice such as by wax or pitch.

During the grinding of a lens on the machine of the present invention the horizontal radius change is obtained by the abrasive ring 41 shown in FIGS. 7 and 8 whereby if the internal diameter opening of the ring 41 is made with a radius of the desired highest dioptric curve and the opening is rounded to a radius thickness of the abrasive ring and the lens blank is placed against it at various angles, any curve may be obtained ranging from the opening curve to plano or flat. If a lens blank were started with its edge on the top of the internal rounded portion of the abrasive ring 41 and the angle of the abrasive were changed gradually as the lens is moved across the rounded abrasive there would be a gradual change of radius on the lens. With this machine the angle is gradually changed by rocking the movable frame 15 about its pivots 16. Pivot point 16 is through the radial center of the abrasive ring 41 as seen in FIG. 7.

The vertical changing curve of the lens is obtained as shown in FIGS. 3, 4 and 5 in which the arms 27, 28 are pivoted at two different points at the top and bottom of the lens holder 26. The amount of change of curvature and the radius of the starting curve is determined by the length of the arms 27 and 28 and the distance between the pivot points of the upper ends of the arms 27, 28.

While we have referred to the abrasive ring 41 as broadly an abrasive it will be understood that it could be a diamond compound, industrial diamond dust or any abrasive material used commerically for polishing lens.

As shown in FIG. 1 the roller guide 34 is riding on a french curve 35 which causes the gear 24 to be rotated through rocking of arm 31.

Referring now to FIGS. 9 and 10, arm 28 is shown longer than arm 27 and is separated by the difference in length at pivot points 29 and 30. FIG. 9 is the starting position while FIG. 10 is the finishing position.

In FIG. 9 the arc of long arm 28 is carried out outside point Y which is the arc that will be cut when point Y passes the grinding point 41. In FIG. 10 the arc of short arm 27 has been carried out inside point X which is the arc that is cut when point X passes the grinding point 41. The angle of the straight line between points X and Y is steeper in FIG. 9 than in FIG. 10, therefore in FIG. 9 the radius actually being cut at the grinding point 41 is the radius of short arm 27 and as the arms are rotated a changing arc will be cut until the position of FIG. 10 is attained when at the grinding point 41 the radius of arm 28 is cut.

Referring now to FIGS. 11 through 14 a modified form of machine for practicing the method and producing the lens of the present invention will be described. An abrasive ring 50 is mounted on a wheel 51 the axle 52 of which is journalled in bearings 53 on a machine frame 54. A motor 55 through pulley and V-belt drive 56 drives the abrasive ring 50.

A work holder frame 57 straddles the working surface of the abrasive ring 50, as best seen in FIG. 12. A work support plate 58 is pivoted on journals 59 mounted in bearings 60. The plate 58 has an opening 61 through which passes the lens rock shaft 62. A bearing plate 63 is retained in place by springs 64 secured to the frame 57 at one end and the plate 63 at the other end.

As best seen in FIG. 13 the other end of the rock shaft 62 is retained in operation position by a washer 65 connected to one end of a spring 66 the other end of which is secured to plate 67 secured to two spacer bars 68 having a slot 69 therebetween. The forward end of the spacer bars 68 are secured to angle iron brackets which are anchored to the holder frame 57.

Lying between the plate 58 and spacer bars 68, as best seen in FIG. 12, is the lens holder 70 secured to two arms 71, 72 which are carried by and secured for rotation with the lens rock shaft 62. Secured to the arm 72 is a toothed quadrant 73 in mesh with a driver worm 74 driven by shaft 75 from motor 76. Arm 71 has a roller 77 rotatably carried thereon which cooperates with an angle iron roller guide 78 secured between the spacer bars 68.

To grind a lens on this machine a blank is placed on the lens holder 70 so that it will be engaged by the periphery of the abrasive ring 50. As the lens commences to seat into the concavity of the periphery of the abrasive ring the motor 76 drives the quadrant and worm which causes the arms 71, 72 to rock with shaft 62 downwardly in the direction of the arrow in FIG. 13. The roller 77 riding up the angle iron roller guide 78 will cause the rock shaft to move in the direction of the arrows in FIG. 12 which causes the plate 58 to swing in the direction of the arrow which springs 64 permit it to do so does spring 66 in permitting the shaft 62 which moves to the left in slot 69, shown in FIG. 13, extending spring 66. The resultant transfer of mechanism results in wiping the lens blank across the concavity of the periphery of the rotating abrasive wheel to grind the lens of the present invention.

What is claimed is:

1. A progressive power lens blank forming machine comprising:

a. a static frame,

b. a movable frame pivoted for movement relative to said static frame,

c. lens grinding abrasive means mounted for rotation upon said movable frame,

d. a first control means connected between said static and movable frame for regulating the amount of pivotal movement between said frames,

e. lens holding means having a base, a pair of arms one end of each of which is pivoted to said base, one of said arms being a short arm and the other of said arms being a long arm, said long arm being connected at its upper end to be gear driven from said static support and a complemental gear in mesh therewith and connected to be rotated by said movable frame at a rate proportional to the

rocking movement of said movable frame relative to said static frame to cause wiping of said lens holder across said lens grinding abrasive to grind a lens blank of progressive thickness

f. a second control means connected between said movable frame and said lens holding means regulating the rate of movement of said lens holding means across said abrasive means as said movable frame is moved by said first control means relative to said static frame to cut a lens blank of progressive thickness from one extremity to the other.

2. A machine as claimed in claim **1** wherein said lens grinding abrasive is an annular abrasive ring having its internal diameter rounded on a true radius.

3. A machine as claimed in claim **2** wherein the movable frame is pivoted to the static frame at the plane of the center of the circle upon which the radius of the internal diameter of the annular abrasive ring is struck.

4. A machine as claimed in claim **1** wherein said first control means is a motor driven screw shaft mounted on said static frame and a complementally threaded follower secured to said movable frame for causing rocking movement of said movable frame about its pivotal connection to said static frame.

5. A machine as claimed in claim **1** wherein said second control means comprises a first gear drive pivoted to said static frame and connected to be rocked proportional to relative movement between said static and movable frames, a second gear in mesh with said first gear and connected to rock said lens holding means in its direction of movement toward and away from the abrasive means.

6. A machine as defined in claim **5** further comprising a template and guide means connected between said movable frame and said first gear drive means to vary the rate and angle of wipe of said lens carrier across said abrasive means.

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