Dec. 11, 1934. J. J. McCABE 1,984,074

LENS GRINDING MACHINE

Filed Sept. 10, 1931 11 Sheets-Sheet 1

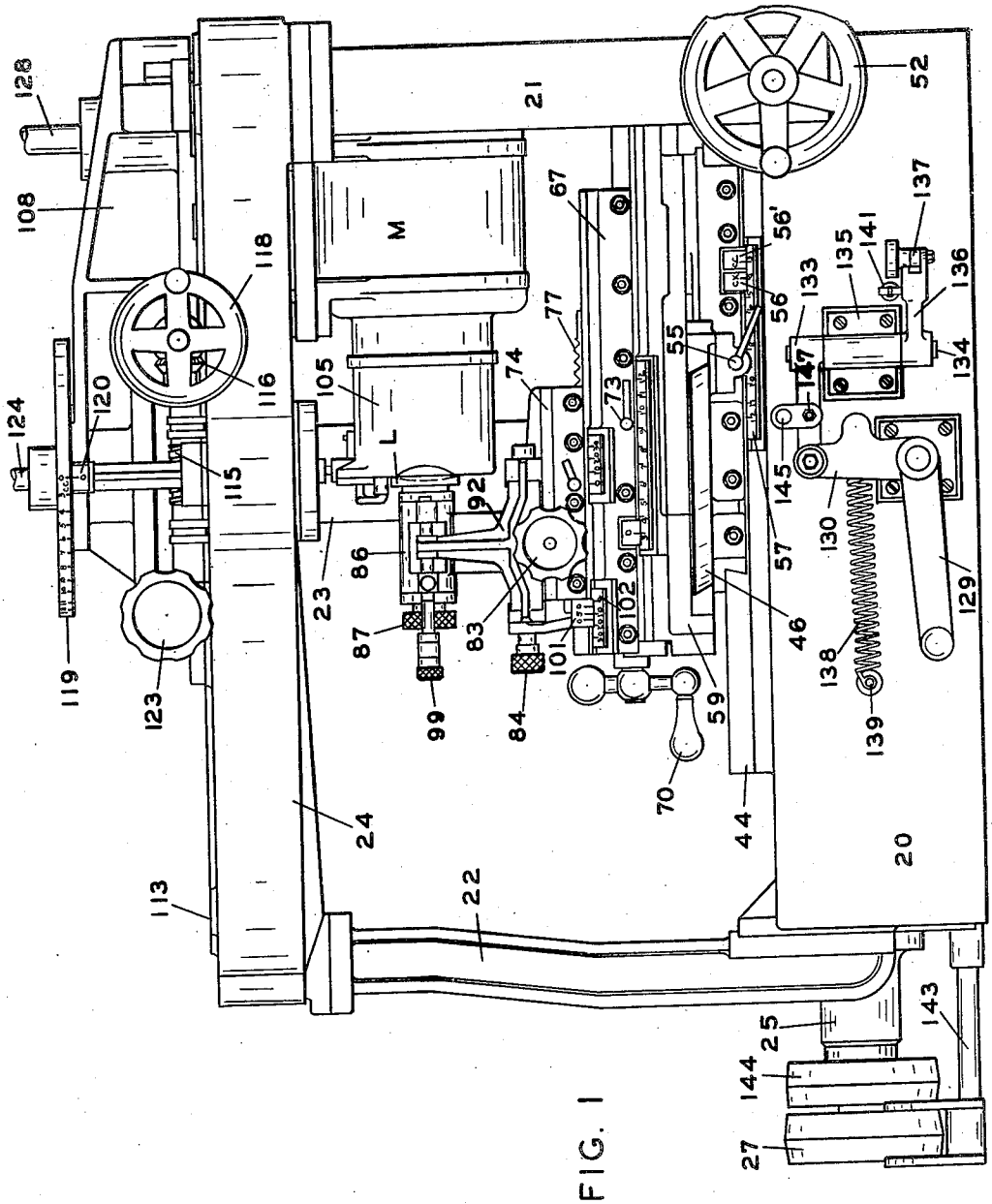


FIG. 1

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LENS GRINDING MACHINE

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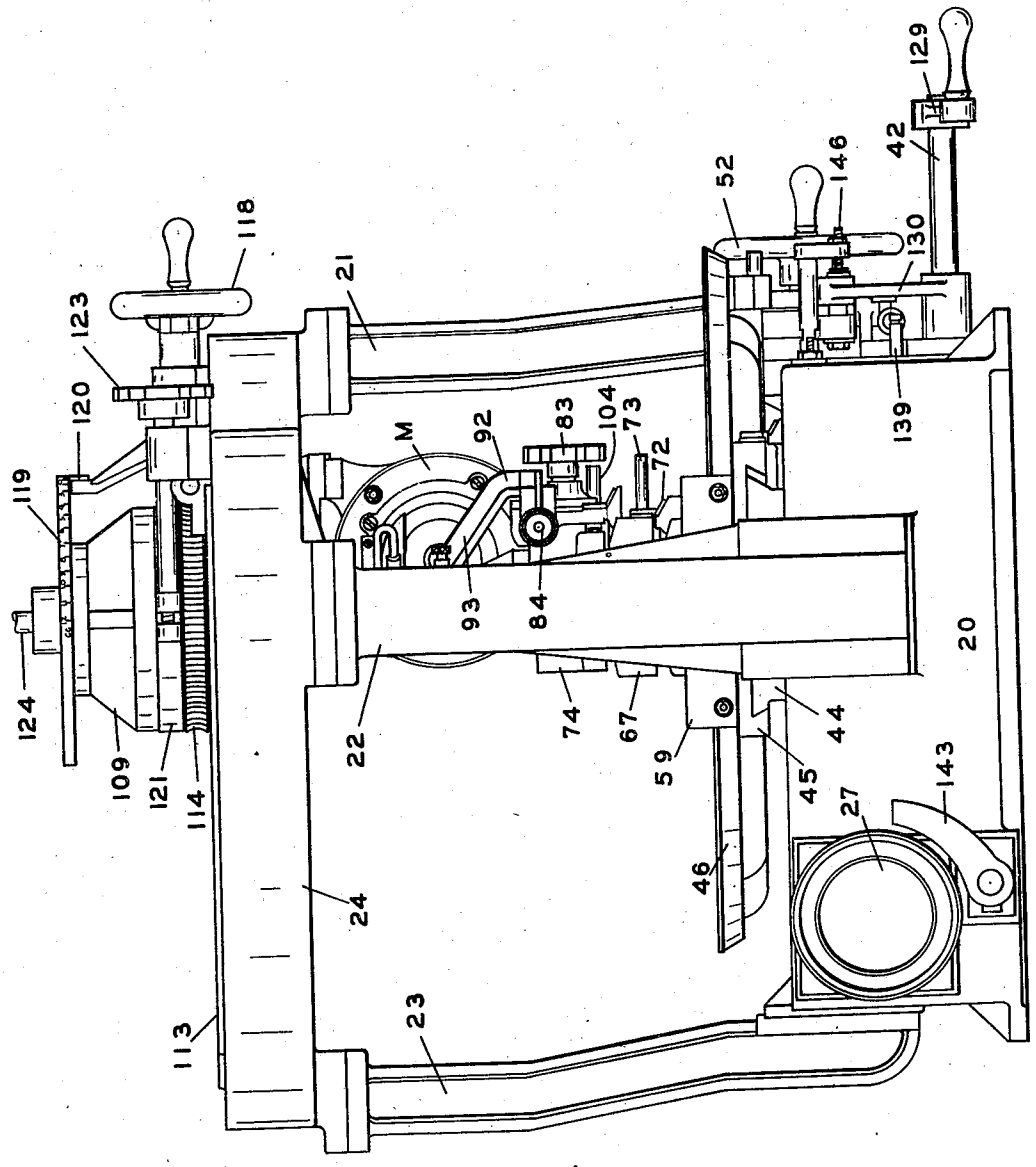


FIG. 2

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LENS GRINDING MACHINE

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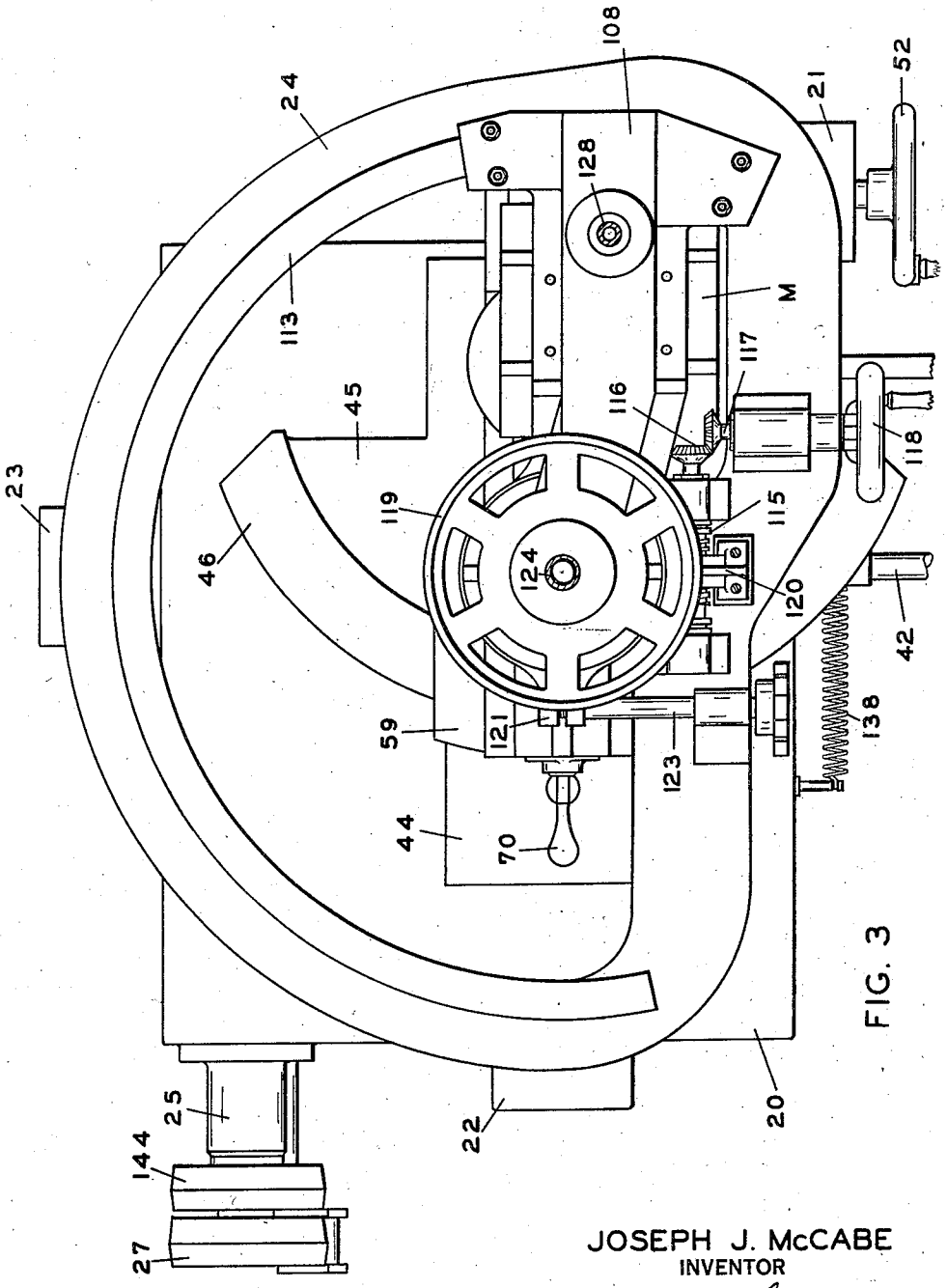


FIG. 3

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LENS GRINDING MACHINE

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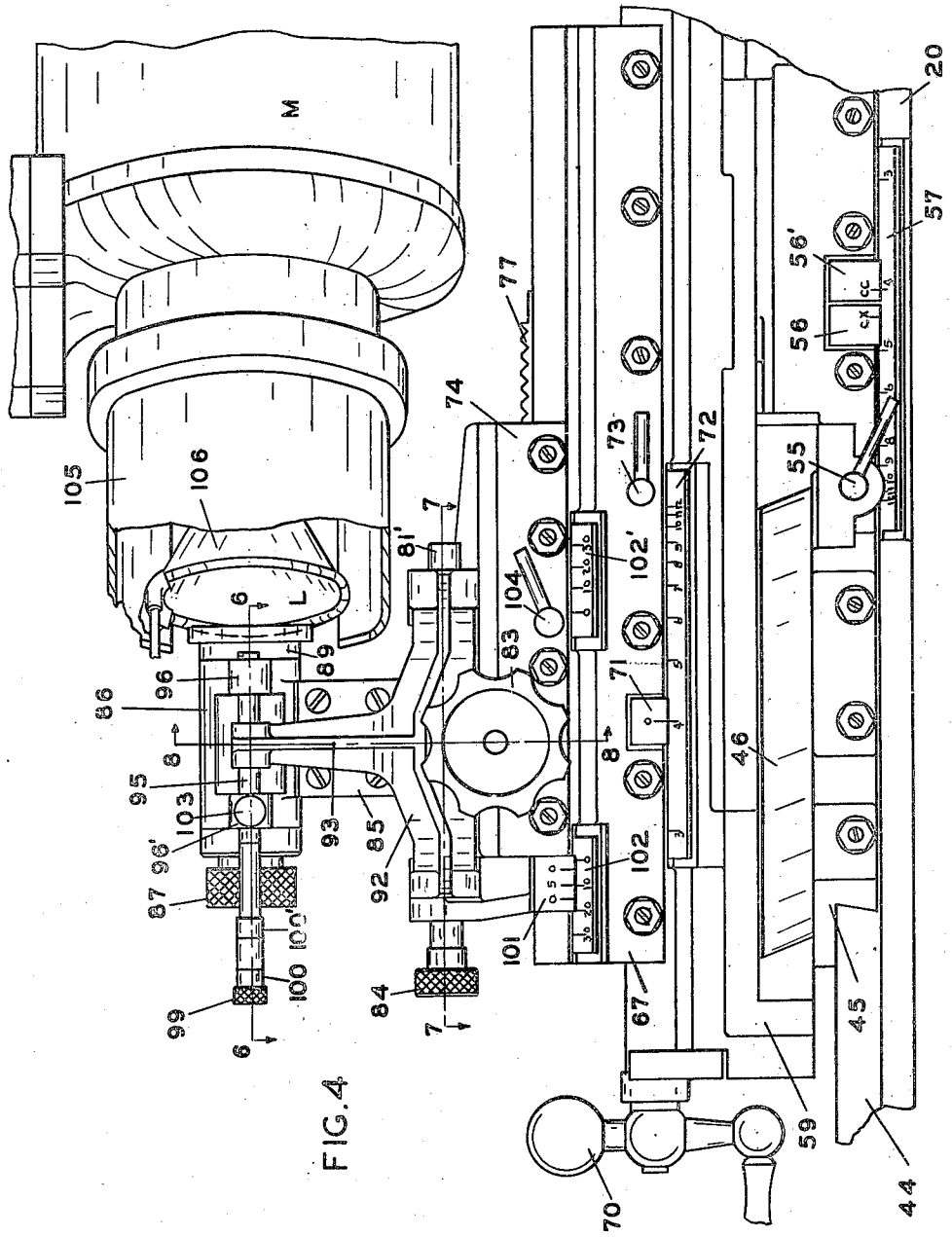


FIG. 4

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LENS GRINDING MACHINE

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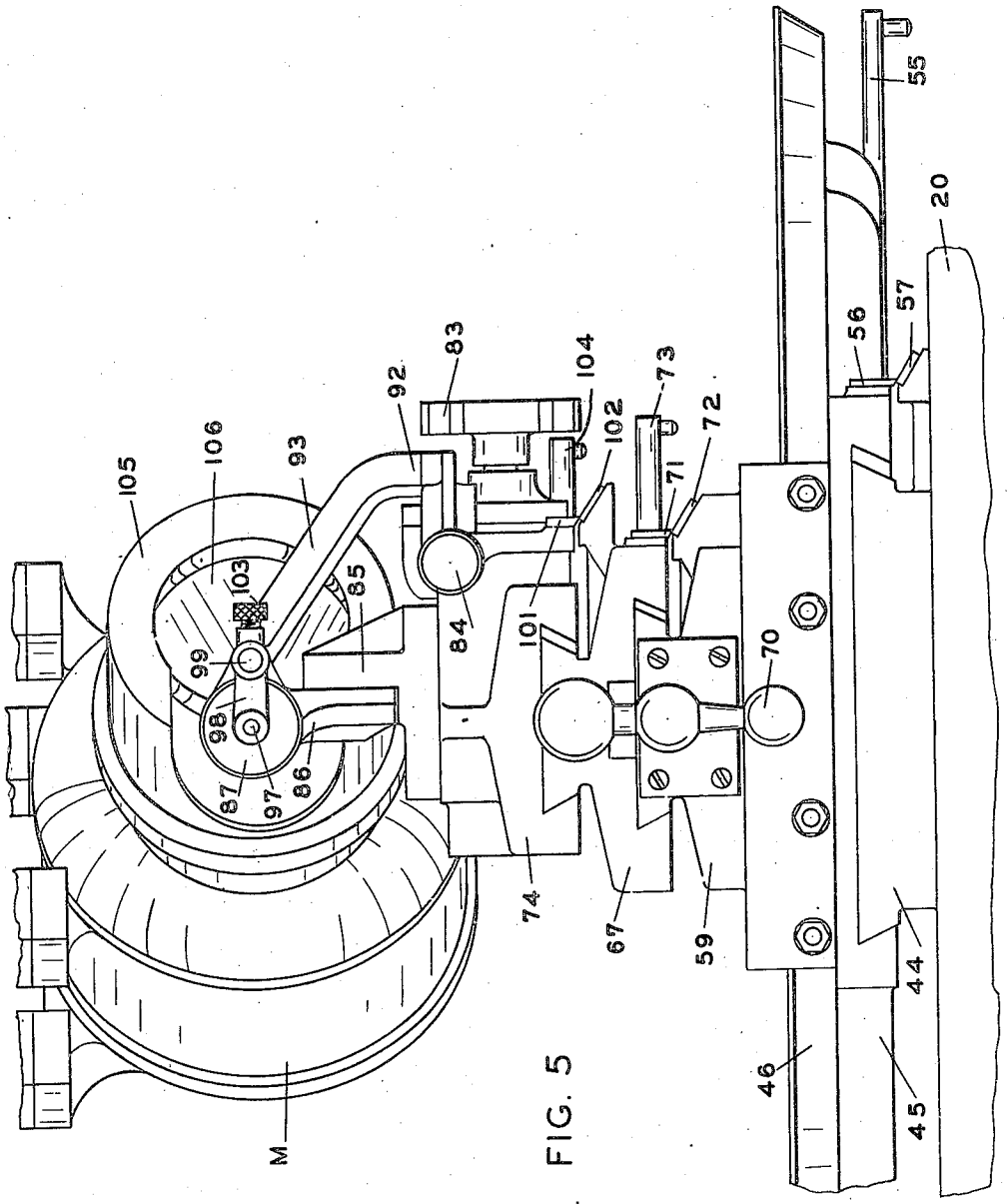


FIG. 5

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LENS GRINDING MACHINE

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FIG. 6

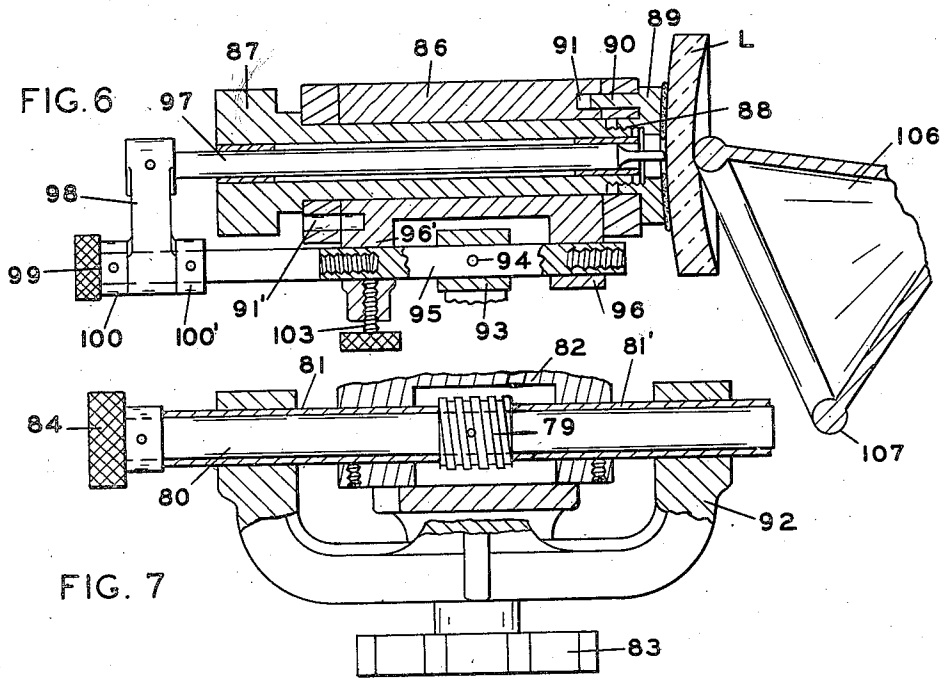


FIG. 7

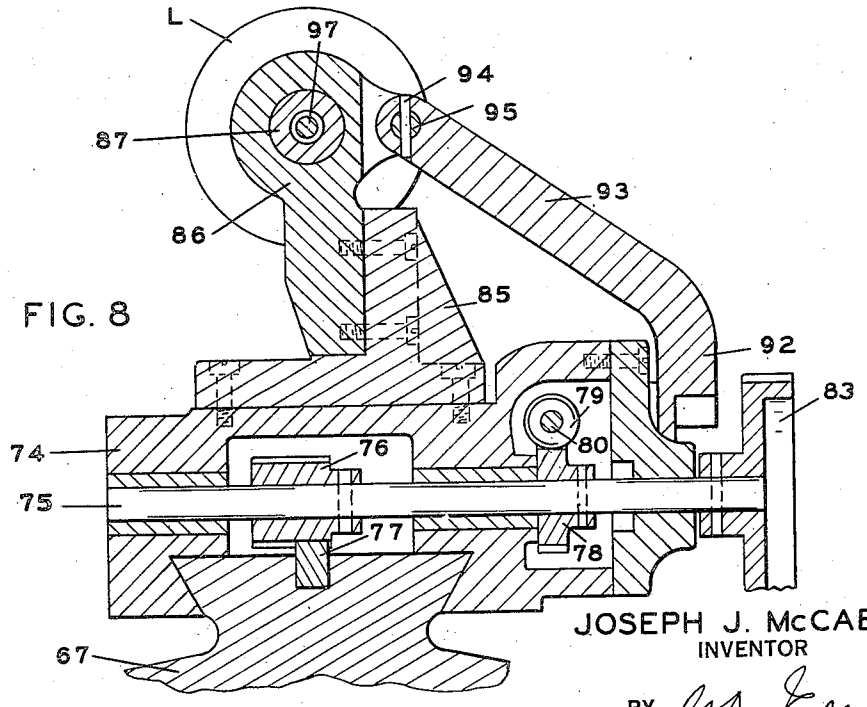


FIG. 8

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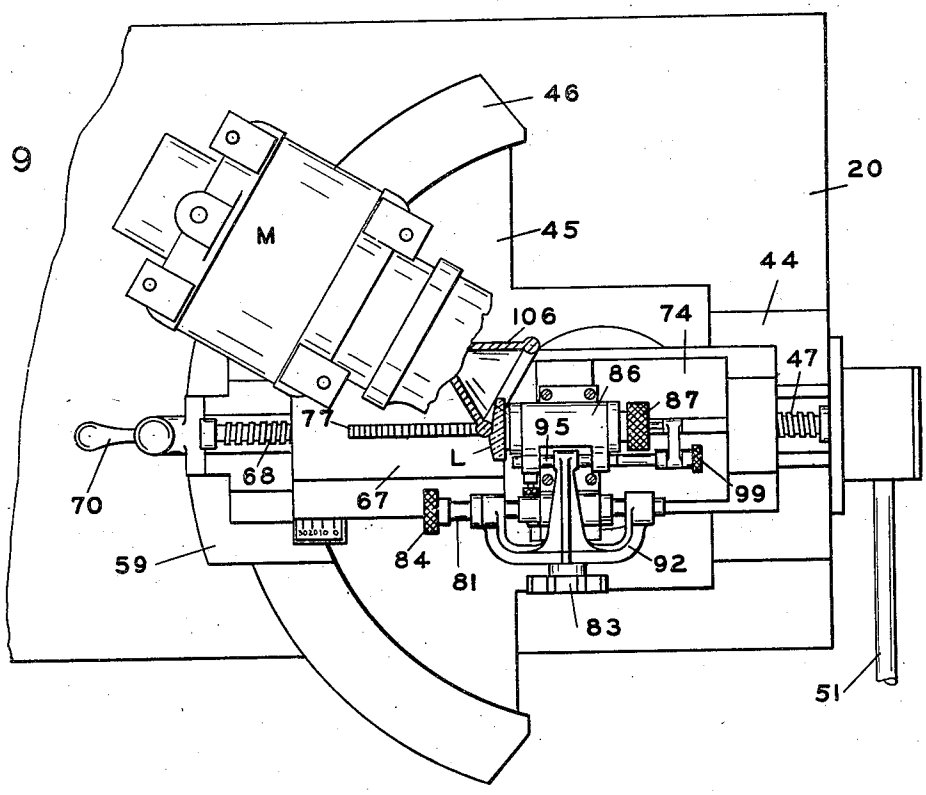
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FIG. 9



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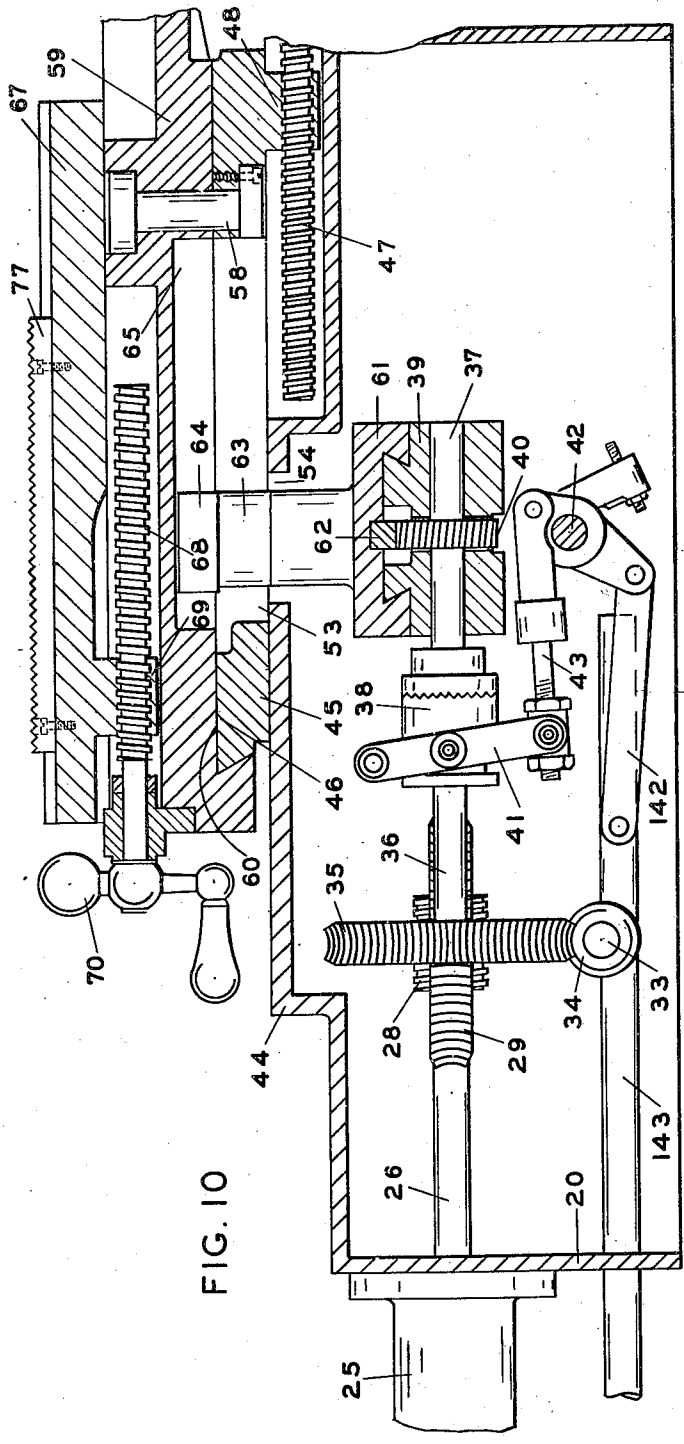


FIG. 10

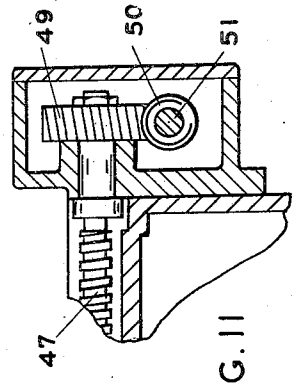


FIG. 11

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LENS GRINDING MACHINE

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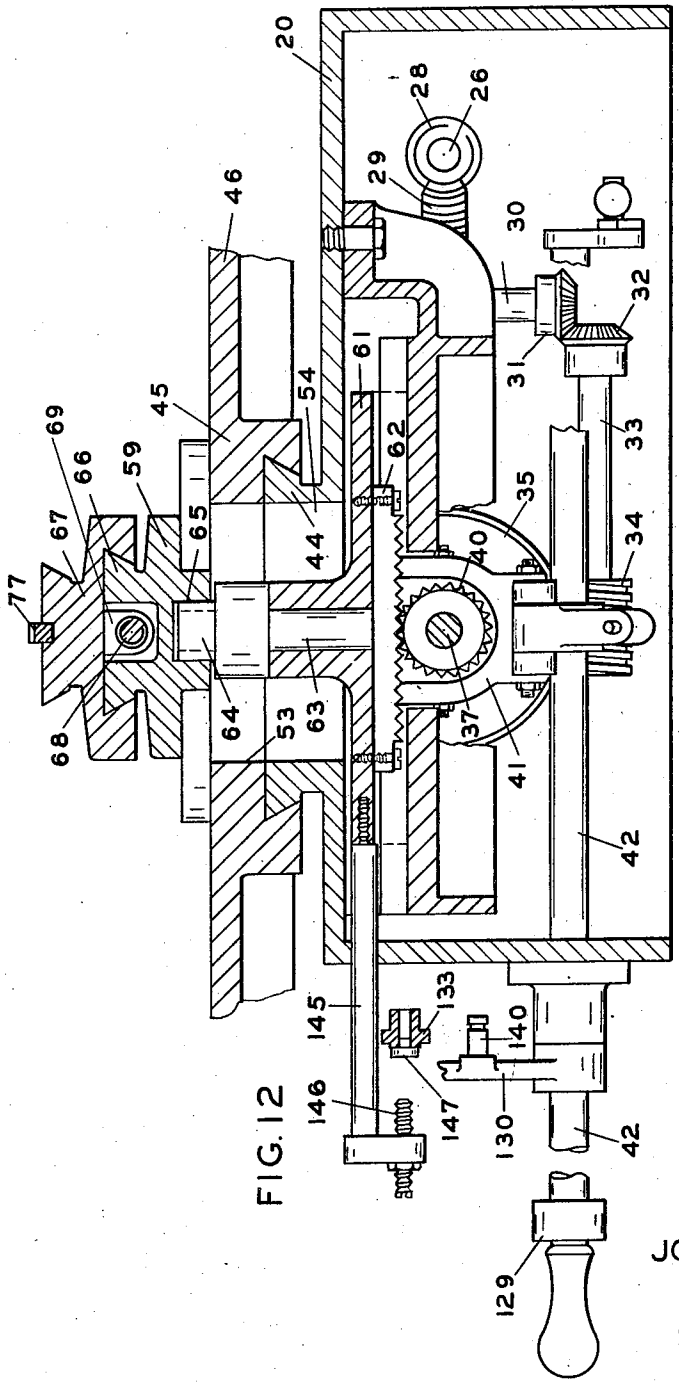


FIG. 12

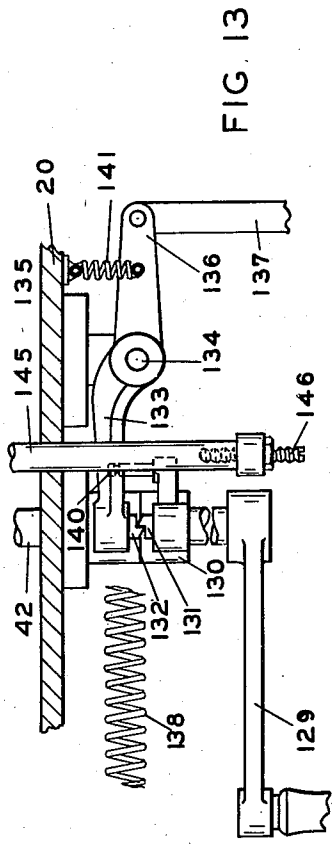


FIG. 13

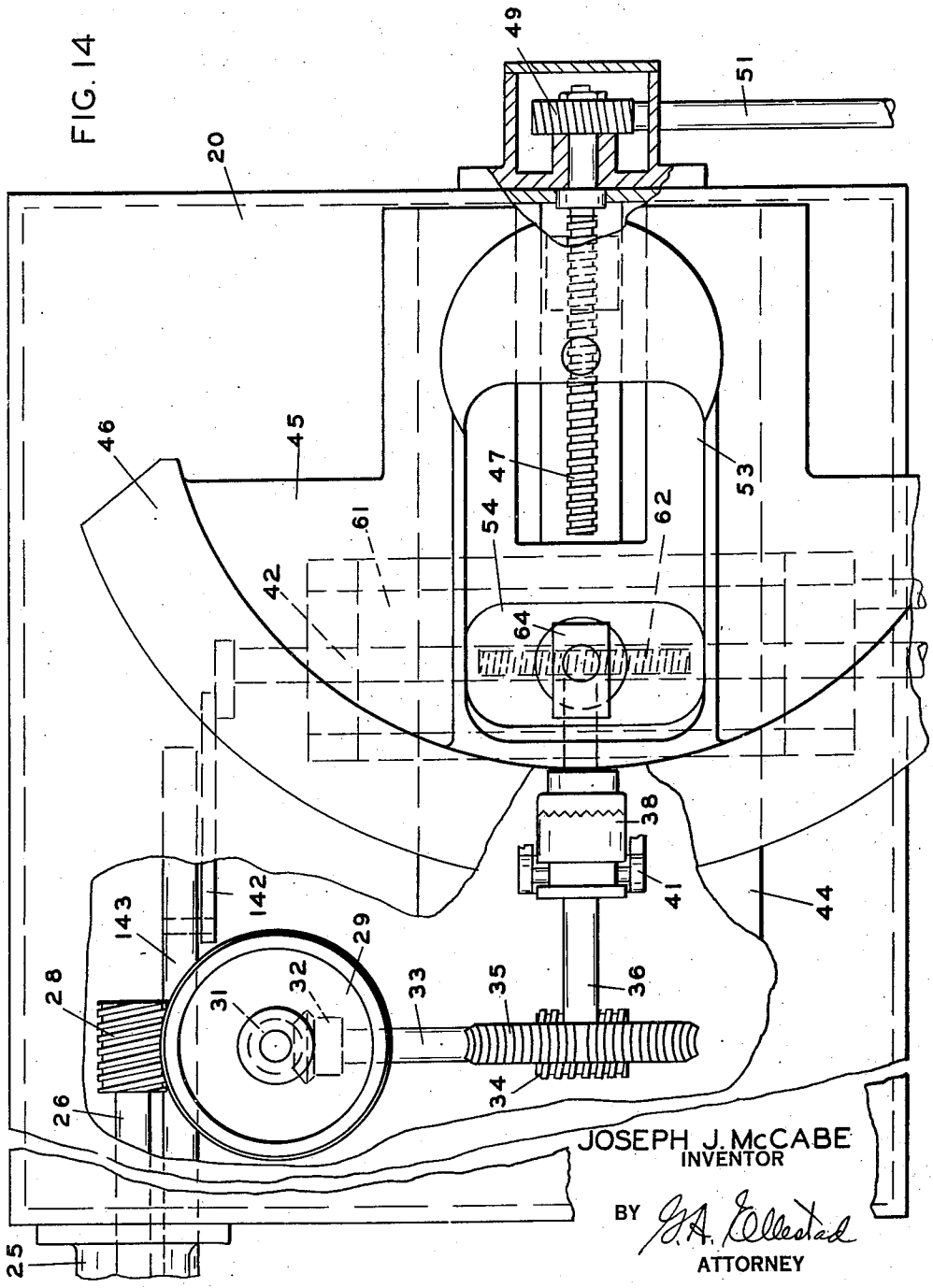
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LENS GRINDING MACHINE

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FIG. 14



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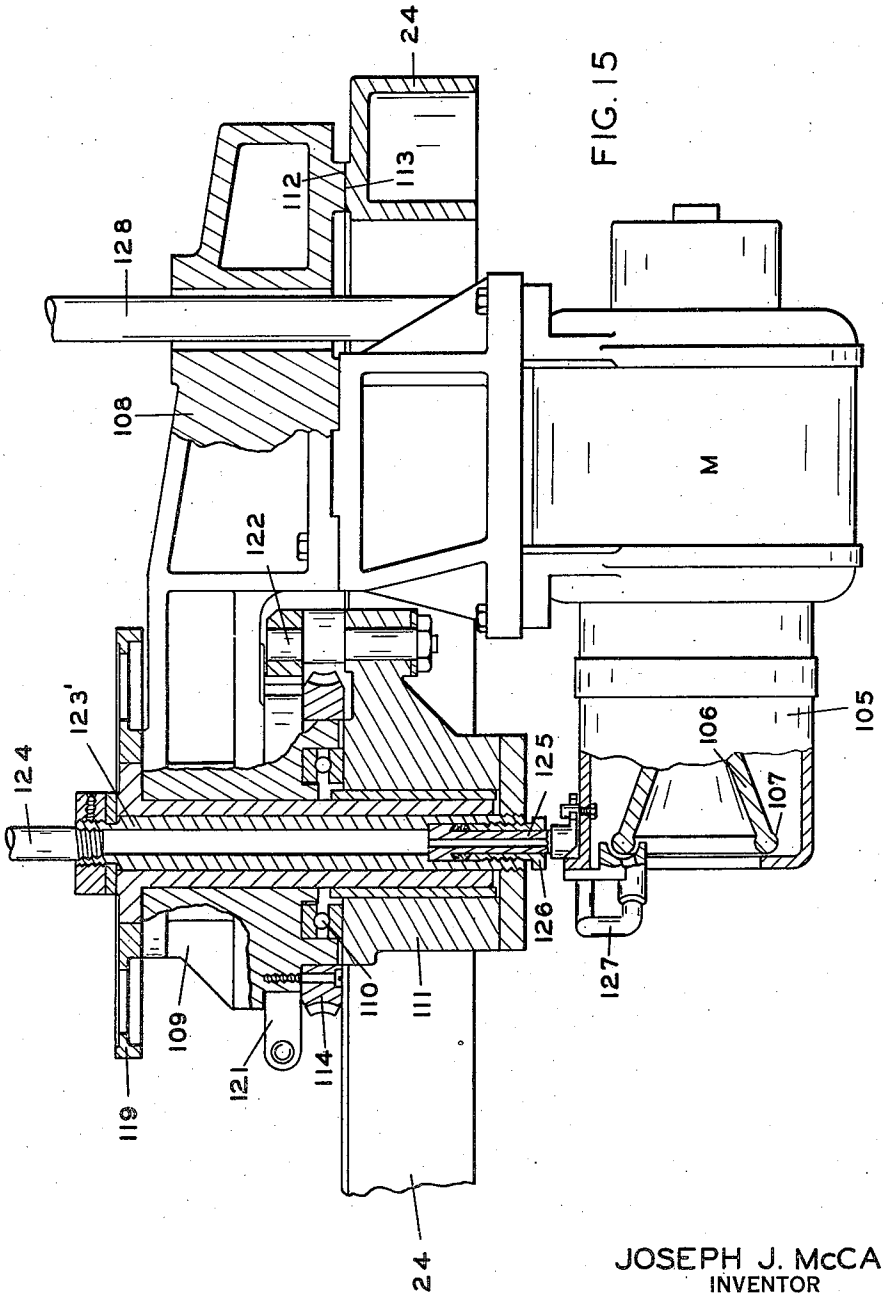
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LENS GRINDING MACHINE

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FIG. 15



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Patented Dec. 11, 1934 1,984,074

UNITED STATES PATENT OFFICE

1,984,074

LENS GRINDING MACHINE

Joseph J. McCabe, Rochester, N. Y., assignor to Bausch & Lomb Optical Company, Rochester, N. Y., a corporation of New York

Application September 10, 1931, Serial No. 562,018

9 Claims. (Cl. 51—124)

This invention relates to lens grinding machinery and more particularly it has reference to a machine for producing spherical and toric surfaces on a lens.

One of the objects of my invention is to provide an improved device which can be efficiently and conveniently used for producing a toric or a spherical surface on a lens. Another object is to provide a machine of the type described which can be efficiently used and set up with a minimum amount of adjustment for grinding a toric surface on either the concave or convex side of a lens. A further object is to provide, in a machine of the type described, an improved means for holding and locating a lens which is to be operated upon. A still further object is to provide an efficient means for supplying a cooling fluid to the abrading or cutting member of a machine of the character described. To these and other ends, the invention resides in certain features and advantages of construction, arrangement and combination of parts as will hereinafter be described, the novel features being pointed out in the appended claims.

Referring to the drawings:

Fig. 1 is a front elevation of my improved lens grinding machine.

Fig. 2 is an end elevation as seen from the left of Fig. 1.

Fig. 3 is a top plan view.

Fig. 4 is an enlarged fragmentary view showing the slides, lens chuck and cutting tool in position to produce a concave surface on a lens blank.

Fig. 5 is an end view as seen from the left of Fig. 4.

Fig. 6 is a sectional view taken on line 6—6 of Fig. 4.

Fig. 7 is a view taken substantially on line 7—7 of Fig. 4.

Fig. 8 is a view taken on line 8—8 of Fig. 4.

Fig. 9 is a top plan view showing the position of the parts when producing a convex surface.

Fig. 10 is a vertical sectional view through the base showing parts of the slides and the power transmitting means.

Fig. 11 is a view of a detail.

Fig. 12 is a sectional view similar to Fig. 10 but substantially at a right angle thereto.

Fig. 13 is a detail view of the means for starting and stopping the machine.

Fig. 14 is a top plan view of the base and base slide, with parts removed.

Fig. 15 is a fragmentary view, partly in section, showing the means for supporting the motor and the method of supplying a cooling fluid to the abrading tool.

Similar reference characters refer to similar parts throughout the several views of the drawings.

One embodiment of my invention is disclosed in the drawings wherein 20 indicates a hollow base having the three upstanding columns 21, 22 and 23 which support a frame 24. Rotatably mounted in a bearing 25 on base 20 is the shaft 26 carrying a pulley 27 which is adapted to be driven by a belt connected to a suitable motor. As shown in Figs. 10, 12 and 14, power is transmitted from shaft 26 by means of worm 28, worm wheel 29, shaft 30, bevel gears 31 and 32, shaft 33, worm 34, and worm wheel 35 to shaft 36 which is connected to shaft 37 by means of a clutch device 38 so that power can be selectively transmitted to shaft 37. The shaft 37 is rotatably mounted in a bearing member 39 and carries a gear wheel 40. The clutch 38 may be thrown in or out of cooperative relation by means of the yoke 41 pivotally connected to shaft 42 by arm 43.

Integral with casing 20 is a track 44 on which is slidably mounted the base slide 45 having an arcuate track 46. The base slide 45 can be moved back and forth longitudinally of the base by means of a rotatable screw 47 which cooperates with a threaded lug 48 integral with the base slide. The screw 47 carries a worm wheel 49 cooperating with a worm 50 on shaft 51 which carries a hand wheel 52 so that the base slide 45 may be moved by turning hand wheel 52, as shown in Figs. 1, 10, 11 and 14. The base slide 45 has an opening 53 which is positioned above an opening 54 in base 20 and track 44 for a purpose to be hereinafter described. The base slide 45 may be locked in adjusted position on track 44 by means of a set screw 55. Mounted on the base slide 45 are the two index plates 56 and 56' which cooperate with a scale 57 on base 20 for a purpose which will hereinafter be described.

On Fig. 10 there is shown, secured to slide 45, a pivot pin 58 about which a swing slide 59 is adapted to turn with a lower face 60 of the swing slide moving along the arcuate track 46. Movably mounted on member 39 is a cross slide 61 carrying a rack 62 which cooperates with gear wheel 40, as shown in Figs. 10 and 12. Rotatably mounted on cross slide 61 is a vertical drive pin 63 on the upper end of which is carried a shoe 64 adapted to slidably engage a groove 65 formed on the under side of swing slide 59. Hence, as power is applied to shaft 37 the slide 61 and shoe 64 are moved and swing slide 59 is swung about the pivot

58. In operation, power is applied so that the swing slide 59 moves towards the rear of the machine or away from the observer as seen in Fig. 1. When the slide 61 has reached the end of its excursion, the clutch 38 is disengaged and the swing slide is moved back to a starting position by hand. The operating pin 63 projects upwardly through openings 53 and 54 so that the slide 61 can always be moved, irrespective of the position of the base slide 45.

As shown in Figs. 4 and 12, the swing slide 59 carries a track 66 on which is movably mounted a top slide 67 adapted to be moved back and forth on track 66 by means of the rotatable screw 68 which cooperates with a threaded portion 69 on slide 67. The screw 68 carries an operating handle 70 and the slide 67 carries an index plate 71 which cooperates with a scale 72 on the swing slide 59 for a purpose which will hereinafter be described. The top slide 67 may be locked in adjusted position by means of a clamping screw 73.

Movably mounted on the top slide 67 is a head slide 74 which carries the lens holding means which will hereinafter be described and which is shown and claimed in United States Patent No. 1,952,212, dated March 27, 1934. Slidably and rotatably mounted in slide 74 is a shaft 75 carrying a pinion 76 which cooperates with a rack 77 secured to the top of slide 67. Shaft 75 also carries another pinion 78 which is adapted to be selectively moved into cooperation with a worm 79 carried by shaft 80 which is rotatably mounted within the two tubes 81 and 81' which are fixed to a member 82 secured to head slide 74 as shown in Figs. 7 and 8. Shaft 75 carries a knob 83 while shaft 80 carries a knob 84. From the foregoing it will be apparent that by pulling out the shaft 75 the pinion 78 will be disengaged from the worm 79 but the pinion 76 will still engage rack 77 so that the head slide 74 may be moved back and forth by turning knob 83. When an approximate position of the slide 74 is reached, the shaft 75 is pushed inwardly so that the pinion 78 engages worm 79 and fine adjustment of the head slide 74 can then be secured by turning knob 84.

Referring to Figs. 6, 7 and 8, there is secured to slide 74 a support 85 carrying a cylindrical member 86 within which is rotatably mounted a bushing 87 having a threaded portion 88 adapted to engage a threaded portion on the lens block 89 to which a lens blank L is cemented. The lens block has a locating pin 90 adapted to selectively cooperate with either of the openings 91 or 91' in the member 86, as will be hereinafter described. Slidably mounted on the rigidly held tubes 81 and 81' is a bracket 92 having an upwardly projecting arm 93 which is secured by a pin 94 to a rod 95 which is slidably mounted in bearings 96 and 96' formed integral with member 86. Slidably mounted within the bushing 87 is the locating pin 97 which is fixedly secured to one end of link 98. In the other end of link 98 a screw 99, held in place by collars 100 and 100', is rotatably mounted. The end of the screw is adapted to selectively engage either threaded end of rod 95. When the screw 99 is threaded into rod 95 and the locating pin 97 is moved into contact with the rear surface of lens blank L, the rod 95 slides in its bearings and the attached bracket 92 slides on the tubes 81 and 81'. Secured to bracket 92 and depending therefrom is an index plate 101 which is adapted to selectively cooperate with either scale 102 or 102', both of which are secured to slide 67, as shown in Fig. 4. The rod 95 is locked in adjusted position by set screw 103 and after the index plate 101 has thus been adjusted and locked, the slide 74 and the entire mechanism carried thereby are adjusted by turning knobs 83 and 84 and locked in adjusted position by set screw 104.

Referring now to Figs. 1, 2, 3 and 15, there is shown a motor M having a casing 105 within which is rotatably mounted, on the shaft of motor M, the abrading or cutting wheel 106 which is a conical cup wheel having an arcuate operating surface 107 which contacts with the lens blank L during operation. The motor M is suspended from an arm 108 which is formed integral with a central casting 109 which is adjustably mounted to turn on the ball bearings 110 carried by boss 111 formed integral with upper frame 24. As the casting 109 turns, the arm 108 and the motor M move with it, the arm moving in an arcuate path with the surface 112 riding on a track 113 formed on frame 24. Secured to the casting 109 is the worm wheel 114 which cooperates with a worm 115 connected by bevel gears 116 to a shaft 117 carrying a hand wheel 118. A circular scale 119 turns with the casting 109 and cooperates with an index plate 120 fixedly secured to the top frame 24. By turning the hand wheel 118 the motor M and cutting wheel 106 may be angularly adjusted about a vertical axis which passes through the center of curvature of the arcuate surface 107 of the abrading wheel 106 and the angular position of the wheel 106 may be determined from scale 119. A split ring 121, held against turning by pin 122, may be tightened by screw 123 to lock the casting 109 in adjusted position.

Fixedly mounted within central bores in casting 109 and boss 111 is a tube 123' which is connected to a pipe 124 which conducts a stream of cooling liquid from a pump, not shown. Fixedly secured to casing 105 is a bushing 125 which is rotatably mounted in the lower end of tube 123'. A suitable packing gland 126 affords a liquid tight connection. Connected to bushing 125 is a pipe 127 which is arranged so as to direct the liquid onto the operating surface of wheel 106. A suitable supply of liquid is thus directed onto wheel 106 irrespective of its angular position. A conduit 128, moving with the motor M, carries suitable wires for supplying electric current to the motor.

A clutch arrangement for starting and stopping the machine is illustrated in Figs. 1, 10, 12 and 13 wherein there is shown a starting crank 129 mounted on shaft 42. Fixedly secured to shaft 42 is a link 130 carrying a clutch finger 131 adapted to cooperate with a clutch finger 132 mounted on lever 133 fixed to a shaft 134 which is pivotally carried by a bearing 135 secured to the front of base 20. Also fixed to shaft 135 is a link 136 having a forwardly projecting handle 137. A coil spring 138 has one of its ends secured to pin 139 on base 20 while the other end is secured to a pin 140 carried by link 130 so that the spring tends to move shaft 42 in a counter-clockwise direction. Another coil spring 141 connected to base 20 tends to hold the link 136 back against the base. Connected by a pivoted link 142 to shaft 42 is a slidably mounted belt shifter 143 which can be selectively operated to shift a belt from the tight pulley 27 to the loose pulley 144 or vice versa. Fixedly secured to slide 61 is a rod 145 which projects forwardly through an opening in base 20 and carries a contact pin 146. When the crank 129 and link 130 are in the position shown in Fig. 1, the machine is set to operate and the clutch fingers 131 and 132 are in the position shown in

Fig. 13. The slide 61 moves rearwardly until, at the end of the stroke, the contact pin 146 strikes a stop 147 on lever 133 whereupon the latter moves backward, the clutch fingers are disengaged, the shaft 42 moves counter-clockwise, the clutch 38 is disengaged and the belt is shifted to the loose pulley 144. If it is desired to suddenly stop the machine in an emergency, it is only necessary for the operator to pull the handle 137 towards himself, thereby moving lever 133 backwards to disengage the clutch fingers and stop the machine as hereinbefore recited. When the clutch 38 is disengaged the belt shifter moves the belt from the tight pulley 27 to the loose pulley 144.

The general operation of the machine is similar to that of the toric generator described in United States Patent No. 1,901,181 issued on March 14, 1933. In operating the device of the instant application for generating a concave toric surface, the base slide 45 is adjusted so that the index 56' indicates on scale 57 the dioptric curvature desired for one meridian of the lens surface. The base slide 45 is then locked in position and the top slide 67 is adjusted so that the index 71 indicates on scale 72 the same dioptric curvature, after which slide 67 is locked in position. The cross curve of the toric surface, which is in the other major meridian, is then set by adjusting the angular position of the motor M and tool 106 by means of wheel 118 so that the desired curvature is indicated on the scale 119 and the motor M and tool are locked in position by means of screw 123.

The lens block 89 carrying a suitably mounted lens blank L is then secured in position by tightening threaded bushing 87. Set screw 103 is loosened, the locating pin 97 is moved into contact with the rear surface of lens blank L and set screw 103 is tightened. The slide 74 is then adjustably positioned by means of knobs 83 and 84 so that index 101 indicates on scale 102 the desired center thickness of the finished lens, after which slide 74 is locked in position. Since the clutch 38 is disconnected, the swing slide 59 and the super-structure carried thereby are moved forwardly, by hand, along the track 46. The starting lever 129 is then moved clockwise to engage the clutch 38, shift the belt to pulley 27 and so render the machine operative. The swing slide 59 is thus gradually moved rearwardly along the arcuate track 46 and so carries the lens blank L in an arcuate path and into contact with the abrading wheel 106. When the swing slide 59 reaches the end of its rearward excursion, the contact pin 146 strikes the stop 147 on lever 133 which releases the clutch fingers 131 and 132 so that clutch 38 is disengaged and the belt is shifted to pulley 144, thereby stopping the operation of the machine.

When it is desired to produce a convex toric surface, a somewhat similar procedure is followed. In making the settings for a convex surface, the index 56 is used in conjunction with scale 57 and the motor M and wheel 106 are turned so that the index 120 cooperates with another dioptric scale, not shown, opposite scale 119. The threaded bushing 87, the pin 97 and the rod 99 are positioned at the other end of tubular member 86 so that the lens blank and parts are positioned as shown in Fig. 9. The pin 90 on the lens block 89 then cooperates with the opening 91' in member 86 and index 101 cooperates with scale 102' to indicate the thickness of the finished lens. The lens blank is carried in an arcuate path into contact with the abrading tool 106 and the general operation of the machine is the same as when generating a concave toric surface.

The lens blank L can be accurately and quickly cemented to the lens block 89 by the use of the lens blocking stand disclosed in my co-pending application Serial No. 556,147 filed August 10, 1931. By the use of this blocking stand it is possible to properly block a lens so that the cylinder axis, optical center, amount of prism and base of prism can be positioned and controlled accurately.

The cutting or abrading wheel 106 may be formed of any suitable substance though I prefer to make the wheel of copper and embed diamonds in the working surface. During the cutting or abrading operation the wheel 106 is supplied with any suitable cooling fluid and the entire machine is preferably enclosed within a cabinet so that the cooling fluid does not spatter on the operator and around the shop. By setting the machine so that the curvatures are the same in the two meridians, a spherical surface can be formed on the lens. The terms cutting, abrading, surfacing and grinding, as used in the specification and claims, refer, in general, to any method for removing glass from the lens blank.

From the foregoing it will be apparent that I am able to attain the objects of my invention and provide a machine of the type described which can be conveniently and quickly adjusted to produce spherical and especially toric lens surfaces. Various modifications can obviously be made without departing from the spirit of my invention as pointed out in the appended claims.

I claim:

1. A lens grinding machine having in combination a base, a base slide movably mounted for rectilinear adjustment on said base, said base slide having an arcuate track, a swing slide pivotally mounted on said base slide and adapted to move along said arcuate track, lens holding devices carried by said swing slide and means for moving said swing slide, said means comprising a shoe which slidably engages a groove on said swing slide.

2. A machine of the type described having in combination a base, a base slide movably mounted on said base, a swing slide movably mounted to turn about a pivot pin secured to said base slide, said swing slide having a groove radially positioned with respect to said pivot pin, and means for moving said swing slide, said means comprising a driven cross slide carrying a shoe which slidably engages said groove.

3. A lens surfacing machine having in combination an abrading tool, a slide, a tubular member carried by said slide, means for detachably securing a lens block to said member, a pin slidably mounted within said member and adapted to contact with the surface of a lens carried by said block, a rod fixedly connected to said pin, said rod being slidably mounted on said tubular member, a bracket fixed to said rod, scale means carried by said bracket and means for moving said slide to bring a lens on said block into contact with said abrading tool.

4. A lens grinding machine comprising an annular abrading tool mounted for rotation on a horizontal shaft, said tool being adjustably mounted to turn about a vertical axis to selectively position the shaft of the tool on opposite sides of a vertical plane passing through said axis, means for selectively holding a lens blank on opposite sides of said vertical plane and

means for moving said lens blank in an arcuate path into contact with said abrading tool.

5. A lens grinding machine comprising a rotatable, conical abrading tool having an arcuate abrading surface at its base, said tool being adjustably mounted to turn about a vertical axis passing through the center of curvature of said arcuate surface to selectively position the apex of said tool on opposite sides of a vertical plane passing through said axis for producing convex or concave surfaces, means for selectively holding a lens blank on opposite sides of said plane for producing concave or convex surfaces and means for relatively moving said lens blank and tool into contact along an arcuate path.

6. A lens grinding machine comprising an annular abrading tool mounted for movement about an axis, said tool having an arcuate abrading surface whose center of curvature is at said axis, the limit of angular movement of said tool being substantially 180 degrees, a device for holding a lens blank and means for moving said blank into contact with said tool along an arcuate path, said device having means for selectively holding a blank on either side of a plane passing through said axis for selectively producing either a concave or convex surface on said lens blank.

7. A machine of the character described having in combination a frame, an abrading tool mounted on said frame for adjustment about a vertical axis, a casing surrounding said tool and movable therewith, and means for conducting a fluid to said tool, said means comprising a fixed conduit and a rotatable bushing, said bushing being fixed to said casing and concentric to said axis.

8. In a machine of the type described, the combination of a base, a base slide movably mounted on said base, a swing slide mounted to turn on a pivot on said base slide, a top slide movably mounted on said swing slide, a head slide movably mounted on said top slide, the paths of motion of said top slide and head slide being substantially parallel, and lens holding means carried by said head slide, the central, vertical plane of said lens holding means being radially located with respect to the axis of said pivot.

9. A lens grinding machine comprising a tool having an abrading surface which is substantially toroidal in form, means for rotating said tool about a horizontal axis, means for adjusting said tool about a vertical axis to selectively position said surface on opposite sides of a vertical plane passing through said vertical axis, means for selectively holding a lens blank on opposite sides of said vertical plane and means for moving said blank in an arcuate path into contact with said abrading surface.

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