Aug. 23, 1955 L. D. BRONSON 2,715,803

LENS GRINDING AND POLISHING APPARATUS

Filed Nov. 7, 1952 4 Sheets-Sheet 1

Fig. 1.

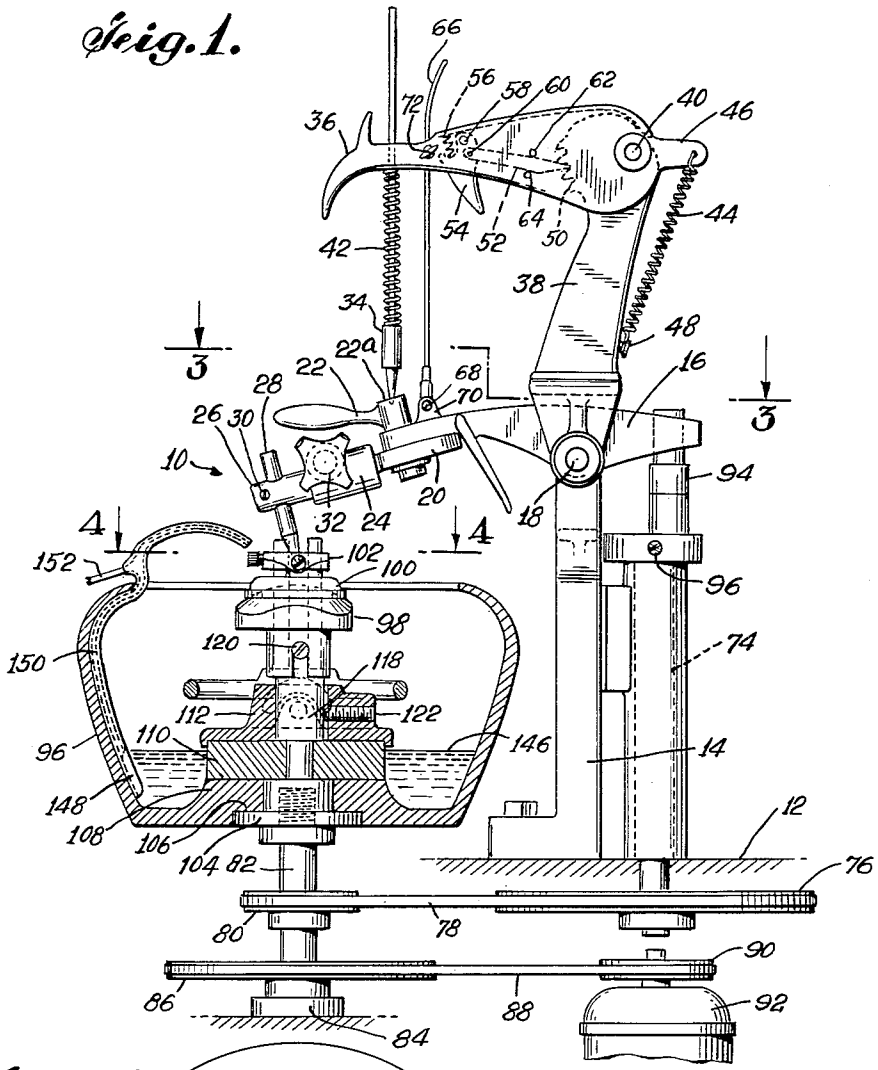
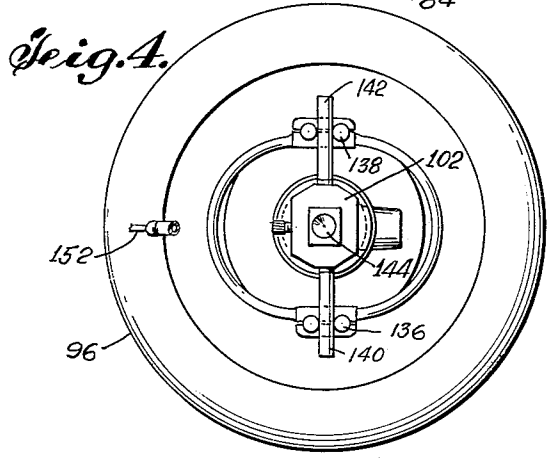


Fig. 4.



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LENS GRINDING AND POLISHING APPARATUS

Filed Nov. 7, 1952 4 Sheets-Sheet 2

Fig. 2.

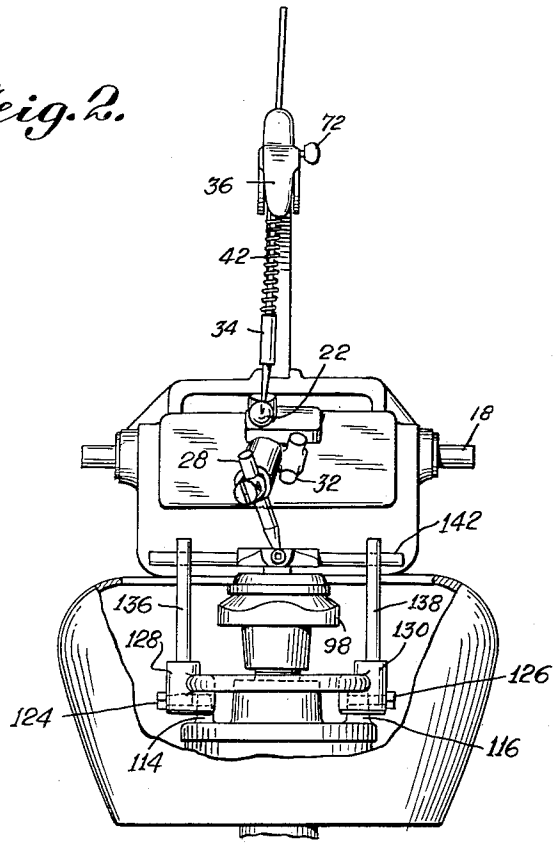
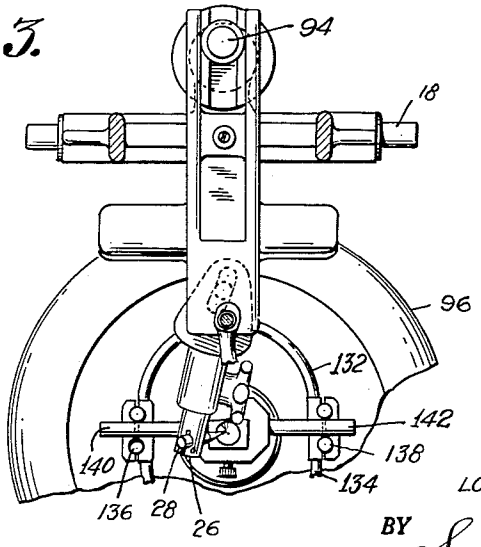


Fig. 3.



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Aug. 23, 1955 L. D. BRONSON 2,715,803

LENS GRINDING AND POLISHING APPARATUS

Filed Nov. 7, 1952 4 Sheets-Sheet 3

Fig. 6.

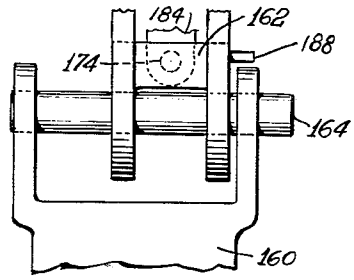
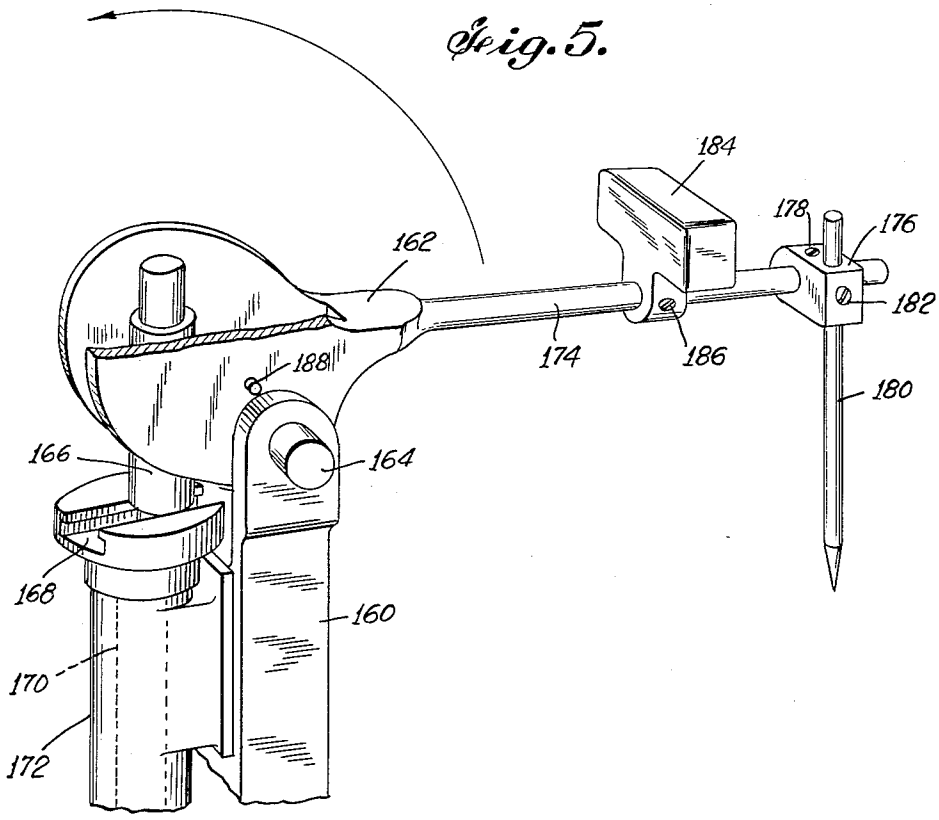


Fig. 5.



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Aug. 23, 1955 L. D. BRONSON 2,715,803

LENS GRINDING AND POLISHING APPARATUS

Filed Nov. 7, 1952 4 Sheets-Sheet 4

Fig. 9.

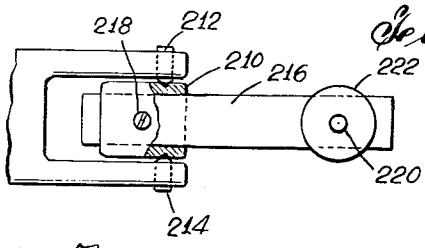


Fig. 7.

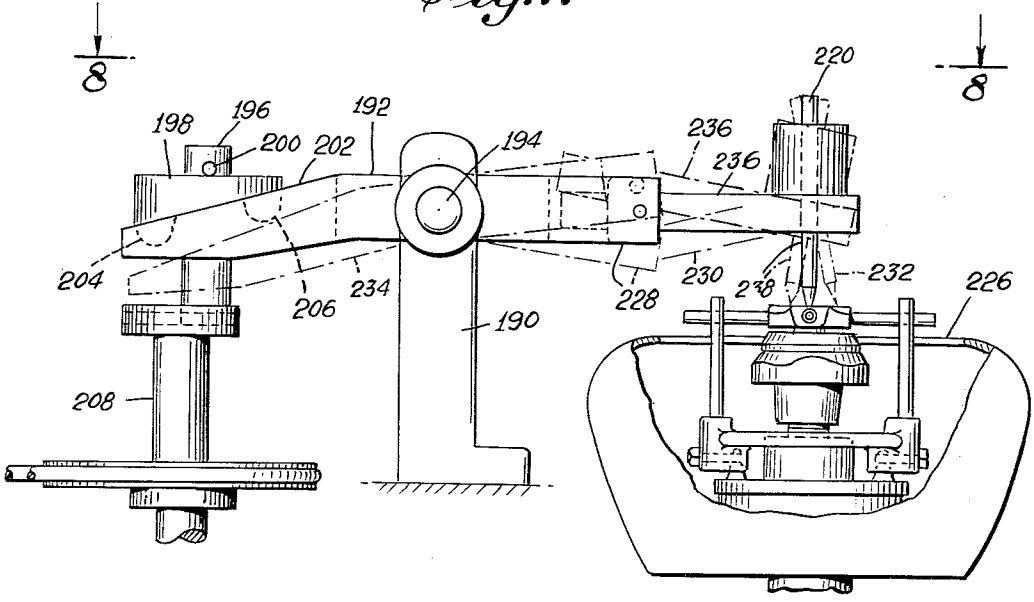
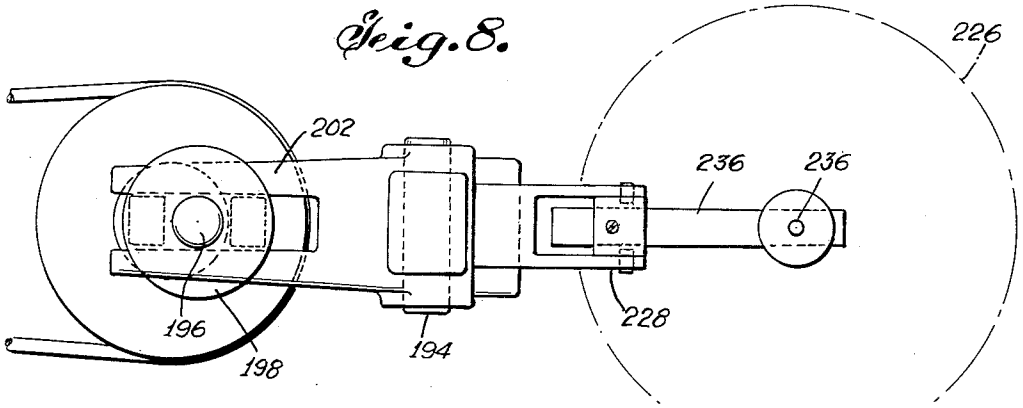


Fig. 8.



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United States Patent Office 2,715,803
Patented Aug. 23, 1955

2,715,803

LENS GRINDING AND POLISHING APPARATUS

Louis D. Bronson, Franklin Square, N. Y.

Application November 7, 1952, Serial No. 319,233

1 Claim. (Cl. 51—124)

This invention relates to lens grinding and polishing apparatus.

The principal object of this invention is the provision of a simple, highly efficient apparatus for spherical and cylindrical grinding and polishing of lens surfaces. As used in this specification, the term "cylindrical" signifies a curved but non-spherical surface, as said term is employed in the optical industry and profession.

Optical grinding and polishing machines may be divided for classification purposes into two categories: Spherical grinding and polishing machines and cylindrical grinding and polishing machines. The conventional spherical grinding and polishing machine is not normally adapted for cylindrical grinding and polishing. Conversely, the conventional cylindrical grinding and polishing machine is not well adapted for spherical grinding and polishing. Consequently, opticians and others in the optical industry find it necessary to procure, maintain and use both a spherical and a cylindrical grinding and polishing machine.

Some efforts have been made to devise a combination machine which would be capable of both types of grinding and polishing and while these efforts have to some extent been successful, the combination machines which these efforts have produced have been overly complicated in their structure and mechanism and cumbersome and faulty in their operation. Consequently, these combination machines have been unnecessarily expensive both to the manufacturer and to the purchaser and user.

The grinding and polishing machine herein claimed is very simple in construction and operation and it consists of relatively few parts which are readily assembled and disassembled for use, replacement, cleaning and other purposes. It occupies relatively little space and its operation is virtually vibrationless. This is in sharp contrast to the combination machines which have thus far been developed, said machines being extremely complicated in construction and operation, occupying an excessive amount of space, and producing violent vibrations in operation.

An important feature of the grinding and polishing apparatus herein described and claimed is the number and direction of the relative movements between the grinding or polishing tool and the work. In a conventional cylindrical grinding and polishing machine, the relative movements are usualy two. The same is true of a conventional spherical grinding and polishing machine. In the combination spherical and cylindrical grinding and polishing machines of the prior art, the relative movements between the tool and the work are normally three. In the present machine there are four. It must be understood that the greater the number of relative movements between the tool and the work, the more efficient the grinding or polishing operation.

In the present machine, the work is mounted on a rotating holder and the tool is mounted on a rotating mandrel. Although the work and the tool rotate simultaneously with each other and at the same angular

speed, means is provided for shifting the work relative to the tool into two directions: forwardly and backwardly and also leftwardly and rightwardly. A fourth motion is also forwardly and backwardly of the work relative to the tool, but such movement differs from the first mentioned forward and backward movement in that it traverses the direction which the latter movement takes as well as the direction which the leftward and rightward movement takes. The fourth motion may therefore be more appropriately described as an angular motion which no other optical grinding and polishing machine now in existence incorporates.

Another important feature of the present invention is the means which it provides for applying the abrasive or polishing liquid to the work and tool. A force feed of such liquid is provided in the present machine without the use of a pump or other pressure means. More specifically, what is here provided is a rotating bowl which contains the abrasive or polishing liquid, a scoop which is held in a stationary position in said bowl adjacent its inner wall, and a tube which is connected at one end to said scoop and which is positioned at its opposite end adjacent the work and tool. As the bowl rotates, the liquid rotates with it and centrifugal force tends to throw it outwardly and against the inner wall of the bowl. The scoop is positioned to intercept or catch the liquid and to channel it up through the tube and against the work and tool.

Still another important feature is the adjustability of the apparatus herein described and claimed. It is adjustable in every conceivable sense, so as to accommodate a lens of virtualy every size and shape (within the physical space limitations of the apparatus), reference being here made to width and length as well as to thickness. The machine is also adjustable to apply varying degrees of pressure upon the work and the tool. It is also adjustable to compensate for wear, particularly of the stylus which presses the work against the tool. The machine is adjustable so as to provide greater or lesser relative movement between the tool and the work.

Simplicity has been mentioned as one of the important features of this machine. An important aspect of this feature is the fact that all of the important operative parts of the machine, with the sole exception of the pressure stylus, are mounted for rotary movement on a common mandrel. Reference is here made to the bowl which contains the abrasive or polishing liquid, the tool, the work holder and hence the work, and the guide means which guide the movement of the work holder and the work relative to the tool.

Preferred forms of this invention are shown in the accompanying drawing in which:

Fig. 1 is a side view, partly in vertical section, of a lens grinding and polishing machine made in accordance with one form of this invention.

Fig. 2 is a front view of the same machine, its bowl being partly broken away to expose its working parts.

Fig. 3 is a horizontal section on line 3—3 of Fig. 1.

Fig. 4 is a top view of the bowl, the tool and the work holder, looking in the direction of arrows 4, 4 of Fig. 1.

Fig. 5 is a fragmentary perspective view of the pressure applying means of a machine made in accordance with a second form of this invention.

Fig. 6 is a fragmentary back view thereof.

Fig. 7 is a side view of a lens grinding and polishing machine made in accordance with the third form of this invention, the bowl being partly broken away to expose its working parts.

Fig. 8 is a top view, partly in section, looking in the direction of arrows 8, 8 of Fig. 7.

Fig. 9 is a fragmentary top view, partly in section, of the stylus-holding means.

Referring now to the first four figures of the drawing,

it will be seen that lens grinding and polishing machine **10**, made in accordance with one form of this invention, may be mounted on a table top **12** or any other suitable support. The machine includes a stand **14** which is mounted on the table and it will be noted that said stand supports the stylus-holding and pressing means. More specifically, it will be seen that stand **14** is bifurcated at its upper end to accommodate a bifurcated horizontal arm **16** which is pivoted on shaft **18**. The shaft is movable longitudinally of itself and hence transversely of the machine as a whole. At the forward end of horizontal arm **16** is a second arm **20** which is clamped to the first arm by means of clamp **22**. When clamp **22** is loose, second arm **20** is free to pivot either leftwardly or rightwardly, as desired or as required. When clamp **22** is tight against the two arms, the second arm is locked against movement relative to the first arm. A collet or chuck **24** is mounted on the second arm **20** and stylus holder **26** is held in said collet or chuck. A hole is formed in the stylus holder to accommodate the stylus **28** and said stylus holder is split and provided with a clamping screw **30** so as to clamp the stylus in place. The stylus holder **26** is rotatable in the collet or chuck and a clamp member **32** is provided with said collet or chuck to lock the stylus holder against rotation therein.

Clamping member **22** is recessed at **22***a* to receive a second stylus **34**. This second stylus projects upwardly through an arm **36** which is pivotally mounted on extension **38** of stand **14**. A horizontal pin **40** provides the pivotal connection between said arm **36** and said extension **38**. It will be noted that a compression spring **42** is mounted on stylus **34** and it will be understood that the action of the compression spring is to urge stylus **34** downwardly against clamp **22** and this has the further effect of urging stylus **28** downwardly and against the work holder, as will hereafter more fully appear. A spring **44** is attached at one end to a rear extension **46** of arm **36** and it is attached at its opposite end to a stud **48** on extension **38** of stand **14**. This tends to support the weight of arm **36** and it also tends to swing it upwardly in clockwise direction as viewed in Fig. 1. To prevent such clockwise movement and to fix the position of said arm **36**, ratchet teeth **50** are provided on extension **38** and a pawl **52** engageable therewith is mounted on a trigger **54** which is pivotally supported on arm **36**. A compression spring **56** acts against the trigger and causes it to hold pawl **52** firmly in engagement with ratchet teeth **50**. It will be noted that the trigger is pivoted on pin **58** and the pawl is pivoted on pin **60**. Pins **62** and **64** serve as guides for the pawl and prevent vertical displacement thereof. When the pawl is in engagement with the ratchet teeth, arm **36** is locked against clockwise movement. The angular position of arm **36** may be adjusted by selective engagement of the pawl with the several ratchet teeth.

When the stylus **28** rests upon the work holder, as shown in Fig. 1, the work holder will serve as a support for the stylus and it will prevent arms **16** and **20** from dropping in counter-clockwise direction. When, however, the work holder is removed from the machine, it is important that provision be made for an auxiliary support for these two arms so that they will not drop below a predetermined point. A wire **66** is accordingly provided to support arms **16** and **20** when the work holder is removed. This wire is secured at its lower end by means of screw or pin **68** to an ear **70** on arm **16**. The upper end of the wire extends through a hole in arm **36** and a thumb-screw **72** is provided to engage the wire and thereby to lock it in place so that it may serve as a hanging support for arms **16** and **20**. It will be understood that this number **66** may be made of other material than wire, a length of cord or a flexible cable being quite satisfactory for this purpose.

Supported by stand **14** is a vertical shaft **74** which is properly journaled for rotation on its vertical, longitudinal axis. The lower end of the shaft has a pulley **76** mounted thereon and said pulley is connected by means of a belt **78** to a second pulley **80**. Pulley **80** is secured to a vertical shaft **82** which is properly journaled in bearing **84** for rotation on its vertical, longitudinal axis. A pulley **86** is also secured to shaft **82** and a belt **88** connects said pulley to a fourth pulley **90** which is mounted on the shaft of motor **92**. It will be understood that the motor drives shaft **74** through the four pulleys and two belts and shaft **82** last above mentioned.

At the top of shaft **74** is an eccentric **94**. This eccentric is adjustable relative to the longitudinal axis of shaft **74** and a set screw **96** is provided for locking said eccentric in any selected position relative to said axis. Naturally, the distance of the eccentric from the axial center of shaft **74** will determine the extent of travel of said eccentric. It will be noted in Fig. 3 that eccentric **94** projects up through the bifurcated end of arm **16**. As shaft **74** rotates, the eccentric acts upon said bifurcated arm **16** and causes it to move sidewardly in both directions along the axis of shaft **18**. This produces one of the movements to which reference has above been made, namely the leftward and rightward movement of the work holder and work, as will more clearly hereafter appear.

Shaft **82** supports bowl **96**, tool **98** and work **100** and it also supports the rest of the mechanism within the bowl, including the work holder **102**. More specifically, a flanged collar or ring **104** is secured to shaft **82** and said collar or ring is mounted in a correspondingly shaped recess **106** formed in the bottom of bowl **96**. It is this ring or collar which actually supports the bowl. A raised platform **108** is provided within the bowl and a disc-shaped block **110** is mounted on said platform. On top of the block is a mounting **112** having a pair of upwardly projecting ears **114** and **116** respectively. A shaft **118** projects up through said mounting **112** and the tool **98** is removably secured to said shaft. Set screw **120** secures the shank of the tool to the shaft and it will be understood that this is but one means of holding the tool in place. Mounting **112** is also removably secured to shaft **118** and a set screw **122** is provided to affix said mounting to said shaft.

A pair of pins **124** and **126** respectively are supported by ears **114** and **116** and these two pins support a pair of brackets **128** and **130**. These brackets are joined by rings **132** and **134** respectively. Supported by brackets **128** and **130** are two pairs of parallel uprights **136** and **138** respectively. It will be understood that these uprights serve as vertical guide posts for the two horizontal rods **140** and **142** of the work holder **102**. It will be understood from the foregoing that the uprights are adapted to move in two ways: they rotate or rather revolve about the axis of shaft **82** and they also engage in pivotal movement about the axes of pins **124** and **126**. These pins are aligned with each other and hence the pivotal movement of the uprights takes place about a common axis.

The work holder **102** is conventional in construction and the two rods which project sidewardly therefrom in opposite directions are aligned on a common axis. These rods project between the uprights and are movable longitudinally of themselves between said uprights. Hence the work holder is movable in three respects: it rotates with the uprights, it engages in pivotal movement with the uprights and it also moves axially of its two rods through or between said uprights.

It will be noted in Fig. 4 that a recess **144** is formed in the top of the work holder **102**. As Fig. 3 clearly shows, stylus **28** projects into said recess and spring **42** acting through stylus **34** serves to apply whatever pressure may be necessary to hold the work in frictional engagement with the tool. Since stylus **28** is off center relative to the axial center of shaft **82**, it will be apparent that when said shaft rotates, relative movement between

the work holder and work on the one hand and the tool on the other hand will take place. It is this relative movement which provides the necessary abrasive or polishing action to grind or polish the lens.

A liquid **146** is contained in bowl **96** and it will be understood that said liquid includes whatever abrasive or polishing agent is conventionally used in operations of this kind. As the bowl rotates on shaft **82**, the liquid tends to rotate with it and to flow up the side wall of the bowl to a certain height. A scoop **148** at the end of a tube **150** is supported by a bracket **152** in such position that it intercepts or catches the liquid and channels it up through said tube and against the work and tool. A steady supply of abrasive or polishing liquid is thereby directed upon the frictionally engaging faces of the tool and the work.

Referring now to Figs. 5 and 6 of the drawing, it will be understood that all of the apparatus which is mounted within the bowl, and also the bowl itself and the means for causing it to rotate are retained intact for the purposes of the modified form of the invention shown in said Figs. 5 and 6. This is a simplified version of the invention and it omits all of the complicated spring and adjustment mechanism shown in Fig. 1 for applying pressure through the stylus **28** upon the work holder. Stand **169** corresponds to stand **14** of the first form of this invention but it does not possess an extension piece corresponding to extension **38** shown in Fig. 1. Stand **160** is bifurcated at its upper end to receive rocker **162** which is mounted on a shaft **164**. Shaft **164** projects through aligned holes in the upper, bifurcated end of stand **160**. Shaft **164** is free to rotate in said holes and also to move axially of itself in either lateral direction. Rocker **162** is itself bifurcated to receive eccentric **166** which is adjustably mounted in channel **168** provided at the top end of vertical shaft **170**. This shaft is journaled within a housing **172** and it is driven by the same means which drives shaft **74** above mentioned. As shaft **170** rotates, the eccentric acts upon the bifurcated rocker **162** and causes it to more leftwardly and rightwardly along the axis of shaft **164**.

Projecting forwardly from rocker **162** is an arm or rod **174** which carries a stylus holder **176**. This stylus holder is adjustably mounted on rod **174** and it may be moved both axially and angularly of said rod. A set screw **178** is provided to fix the stylus holder on the rod in any selected position thereon. It will of course be understood that other clamping means may be provided for the same purpose. A hole is formed in stylus holder **176** to accommodate the stylus **180** and a set screw **182** is provided to engage the stylus and fix it in place in said holder. Between the adjustment of the stylus holder on rod **174** and the adjustment of the stylus in said stylus holder, the point of the stylus may be placed in every conceivable position required for the proper operation of the machine.

The present form of the invention differs also from the first described form in that a weight **184** is provided for applying the necessary pressure to the work holder. The weight shown in the drawing is purely illustrative insofar as size and shape and method of application to rod **174** are concerned. It is slidably mounted on rod **174** for movement longitudinally thereof and a set screw **186** or other clamping means is provided to fix the position of said weight on said rod. Obviously, the same weight will apply different pressures depending upon its distance from the axial center of shaft **164**. Both the stylus holder **176** and weight **184** are removable from rod **174**.

There are times when it is desired to remove the stylus from the work holder without disturbing the general set-up of the machine. This can be done in the present form of the invention by simply swinging rod **174** and everything that is connected to it in counterclockwise direction as indicated by the curved arrow in Fig. 5. A pin **188** in rocker **162** engages stand **160** when rod **174** is elevated to a substantially vertical position so as to prevent it from falling over to the back of the machine.

Figs. 7, 8 and 9 show a third form of the invention. Stand **190** corresponds to stand **160** and rocker **192** corresponds to rocker **162** and shaft **194** corresponds to shaft **164**. Eccentric **196**, like eccentric **166**, projects upwardly through the bifurcated end of the rocker. However, a beveled washer **198** is mounted on eccentric **196** and a pin **200** prevents upward displacement of said washer. Rocker **192** has a complementary bevel **202** against which the bevel of the washer rests. The washer has two downwardly extending tongues **204** and **206** respectively which project into the bifurcated end of the rocker to prevent angular movement of said washer relative to said rocker. As the eccentric revolves about the axis of shaft **208**, the beveled washer is caused to move toward and away from the axis of shaft **194** and consequently said washer is caused to ride up and down the bevel of said rocker. This has the effect of causing the rocker to rock.

The forward end of rocker **192** is also bifurcated to accommodate a block **210**. This block is pivotally mounted on a pair of set screws **212** and **214** which serve as trunnions relative thereto. A longitudinal opening is formed in block **210** to accommodate a bifurcated bar **216**. This bar is movable longitudinally of itself through block **210** and a set screw **218** is provided to lock said bar in place. Stylus **220** projects through the bifurcated end of bar **216** and a weight **222** is mounted on said stylus. The weight rests against the bifurcated end of bar **216** and bears down upon it and upon the stylus. The stylus is adjustable longitudinally of itself through the weight and the bifurcated bar and it is also adjustable longitudinally of the bar through its slot **224** which is formed at its bifurcated end. The bar itself is adjustable both longitudinally and angularly of itself relative to block **210**. Hence the point of the stylus may be placed in any desired location.

The bowl **226** and all of the mechanism mounted within the bowl, as shown in Fig. 7, are as described in connection with the first form of the invention. It will be noted in Fig. 7 that when rocker **192** is caused to rock in clockwise direction, the stylus-supporting bar **216** is caused to rock in counter-clockwise direction and the stylus is thereby thrust forwardly or rightwardly as viewed in Fig. 7. See the interrupted lines **228**, **230** and **232**. Conversely, when rocker **192** is caused to rock in counter-clockwise direction (see dotted lines **234**) rocker **216** rocks in clockwise direction and the stylus is pulled inwardly or leftwardly as viewed in Fig. 7. See interrupted lines **236** and **238**. This rocking motion of the stylus is the fourth type of motion which the present machine is capable of, as has above been indicated.

It will be understood that the foregoing is descriptive of three forms of this invention. Modifications of these three forms, as well as other forms, may be had within the broad principles of the invention and the broad scope of the claim.

I claim:

A lens grinding and polishing machine, comprising a base, a tool rotatably mounted on said base for rotation about a vertical axis, motor driven means connected to said rotatably mounted tool and causing it to rotate about its said vertical axis, a lens holder positioned above said tool for holding a lens in contact with said tool, a pair of guide members pivotally connected to said tool on diametrically opposite sides thereof for pivotal movement about a horizontal axis, said guide members being movable with said tool about its vertical axis of rotation, means connecting said lens holder with said guide members to cause said lens holder to engage in rotary movement with said tool and in pivotal movement with said guide members, said lens holder being free to move relative to the guide members on a line parallel to the

pivotal axis of said guide members, a frame extending upwardly from said base, an arm mounted intermediate its ends on said frame for pivotal movement about a horizontal axis extending transversely of said arm and for lateral movement in both directions along said last mentioned horizontal axis, a stylus pivotally mounted on one end of said arm for pivotal movement about a horizontal axis which is parallel to the last mentioned horizontal axis, said stylus being situated on said arm for engagement with the lens holder, pressure means connected to said stylus and causing it to bear down upon the lens holder and thereby to cause the lens held by said lens holder to bear down upon the tool, and motor driven means connected to the opposite end of said arm and causing it to move laterally along and pivotally about its said horizontal axis, whereby the stylus is caused to rock about its horizontal axis and to move laterally with said arm, said opposite end of the arm being bifurcated and the motor driven means which causes said arm to move along and about its said horizontal axis including

an eccentric which engages said bifurcated end of the arm and engages in movement of revolution about a vertical axis, said bifurcated end of the arm having a sloping portion and said eccentric having a member which engages higher and lower parts of said sloping portion as the eccentric revolves, thereby causing said arm to rock about its said horizontal axis and causing said stylus to rock about its own horizontal axis.

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