Aug. 5, 1969 J. URBACH 3,458,959

APPARATUS AND METHOD FOR EDGE FINISHING CONTACT LENSES

Filed Oct. 24, 1965 2 Sheets-Sheet 1

FIG. 1.

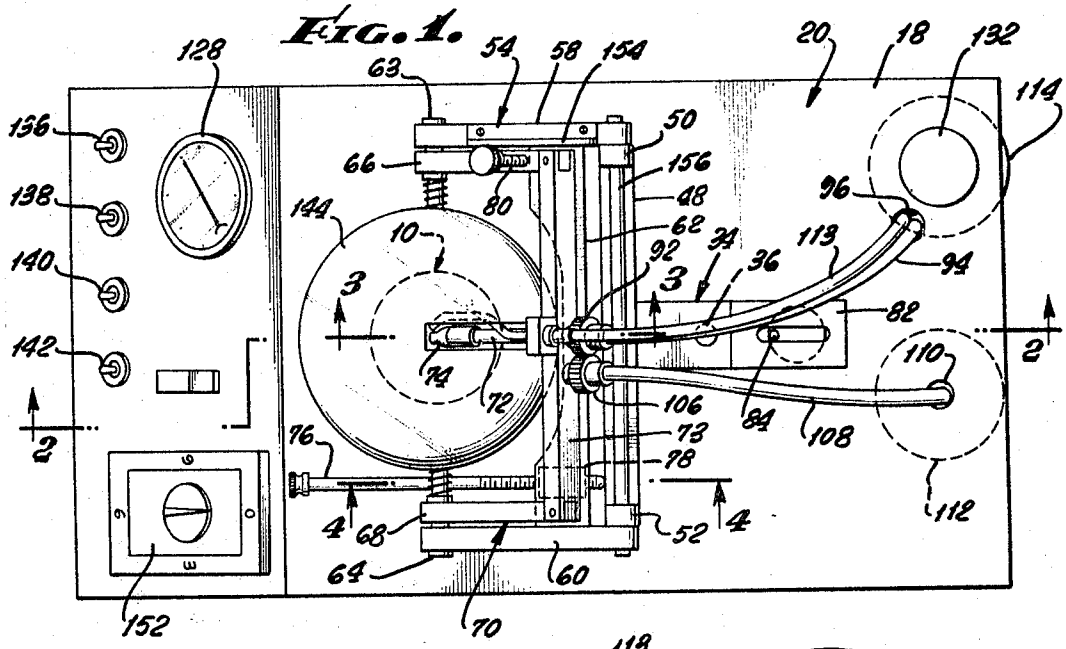
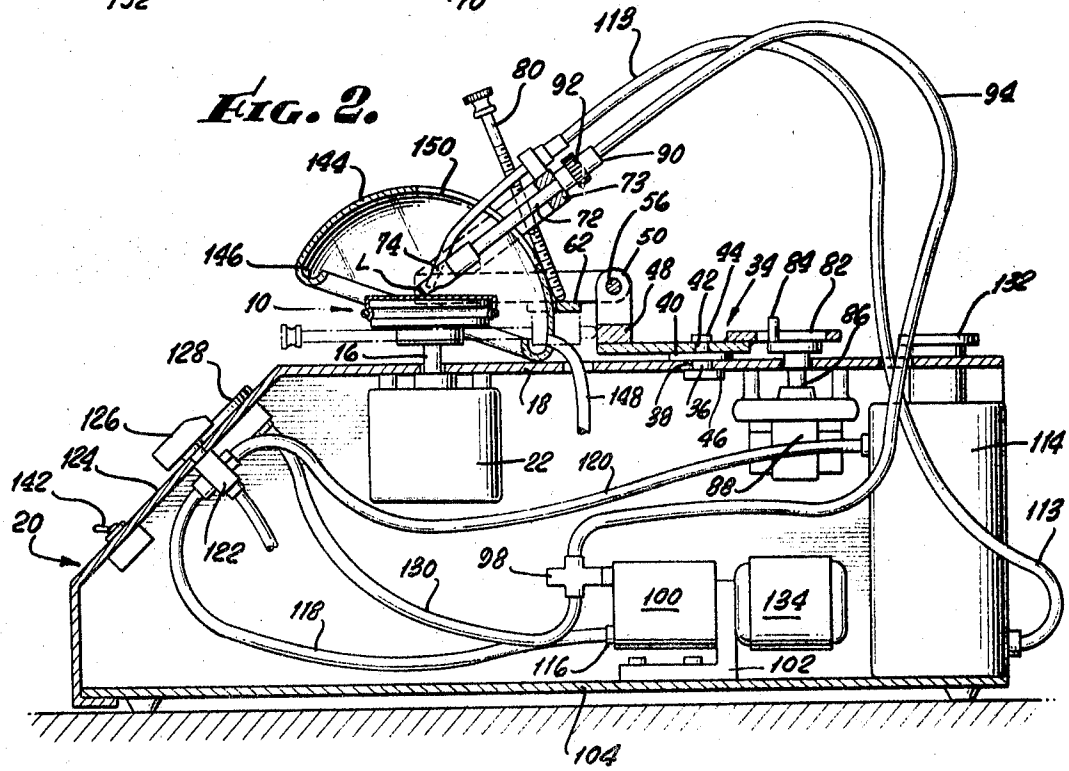


FIG. 2.



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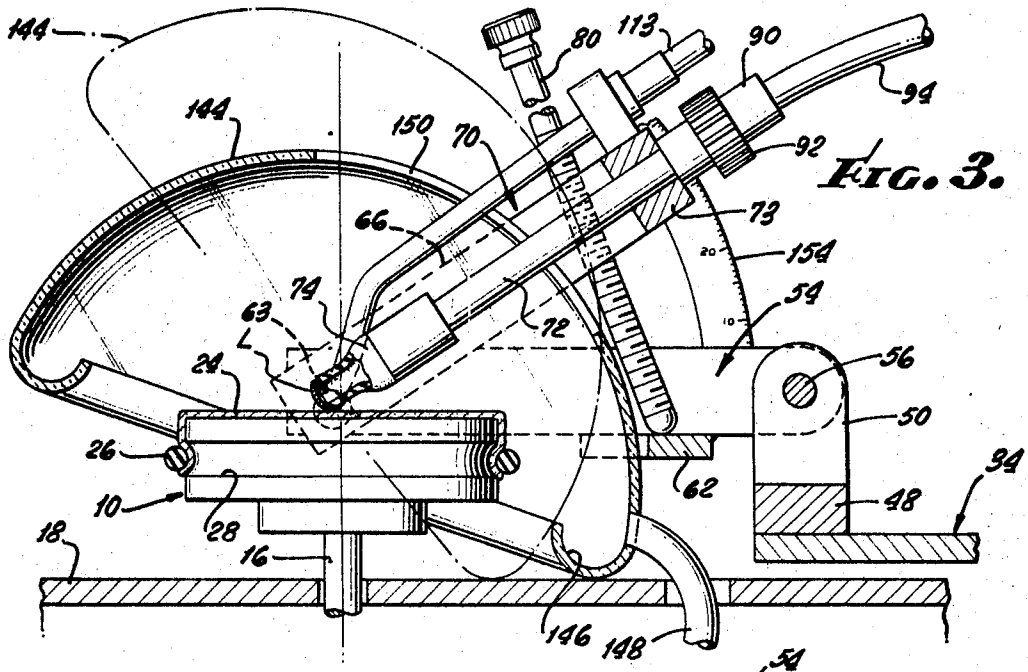


FIG. 3.

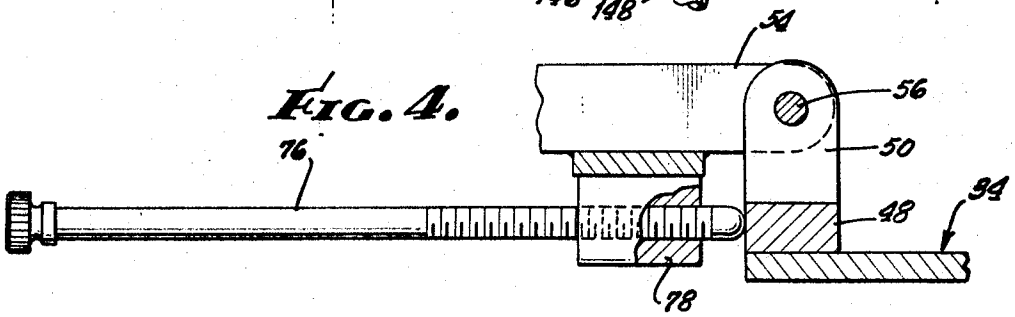
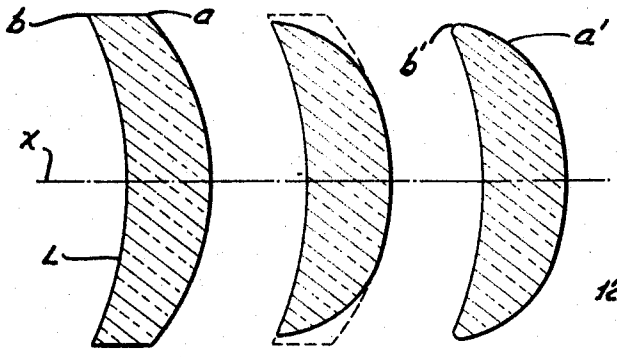


FIG. 4.

FIG. 5. FIG. 6. FIG. 7.



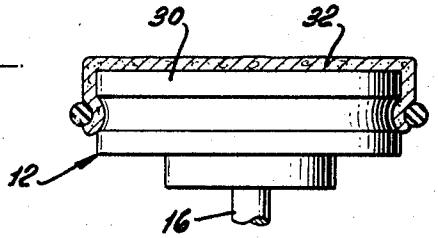


FIG. 8.

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APPARATUS AND METHOD FOR EDGE FINISHING CONTACT LENSES

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U.S. Cl. 51—124 11 Claims

ABSTRACT OF THE DISCLOSURE

A contact lens L (FIG. 3) has its edge finished by polishing operations performed by the aid of a rotating disc **10**. The lens is mounted upon a traverse mechanism. One part **34** (FIGS. 1 and 2) of the mechanism is reciprocated by a drive pin **84**. Another part **54** (FIG. 1) of the traverse mechanism adjustably mounts a holder for the lens L. The holder is carried by a bracket part **73** (FIG. 3). The bracket part **73** is movable to adjust the angle of the holder. For this purpose, the bracket part **73** is angularly adjusted about an axis defined by pins **63** and **64**. The axis is tangent to the edge of the lens at the region of contact with the disc. A screw **76** (FIG. 4) serves as a stop, limiting downward movement of the traverse mechanism part **54**.

SUMMARY OF INVENTION

This invention relates to contact lenses, and particularly to the finishing of the edges thereof.

When the contact lenses are ground to prescription, two sharp annular edges yet remain joined by the peripheral cylindrical surface. These sharp edges must be rounded off. Although some machines have been devised for the purpose of finishing the posterior edge, finishing heretofore has been accomplished largely by hand. Robert B. Mandell, in his work, "Contact Lens Practice," refers to a method in which V-shaped grinding cups of various angularities are progressively used for rounding off and polishing. I have successfully used a different method wherein the hand-held lens is moved across a flat polishing wheel.

Hand finishing, however, is quite tedious; and uniformity is not always achieved. For example, the radius of curvature of the rounded edge may vary; and the distance of the apex of the rounded area from the contact surface of the lens may vary also. Different techniques may be required for lenses of different prescription in order to achieve the desired edge finishing.

Various authorities have suggested various standards; yet precise duplication of edge finish from one lens to another has been virtually impossible. Consequently, the user of contact lenses may suffer discomfort in becoming accustomed to new or replacement lenses.

Known machines have various disadvantages. One important disadvantage is that no known machine is capable of finishing the anterior edge. Other disadvantages are inadequate control of the grinding or polishing process, tedious mounting devices, etc.

The primary object of this invention is to provide precision apparatus capable of finishing both the anterior and posterior edges of the lens, and which is capable of making due allowances for the variations in the prescription curvatures. Another object of this invention is to provide apparatus of this character in which proper placement and removal of the lens is materially simplified.

Another object of this invention is to provide a new reliable method for edge finishing contact lenses. For this purpose, the lens is first positioned to address the anterior

side of the lens to a relatively unyielding disc while rotating the lens about its own axis, inclining the lens axis to the axis of the disc by a controlled amount, and moving the lens substantially diametrically across the polishing disc. Grinding abrasive is applied to the disc. After measurement and inspection, this first stage is terminated when the posterior edge has been fully sharpened, and as confirmed, for example, by a diameter reduction in the lens. The second stage is begun after the lens is reversed to address the posterior side to the rotating disc. A soft yielding disc is substituted, and the posterior edge is finished. Since the lens swings to opposite sides of the disc, the direction of grinding or polishing motion changes from the anterior to the posterior side, and hence the finishing is effectively provided. The angle of inclination of the lens axis determines the ultimate location of the apex of the rounded posterior edge. In practice, two identical machines may be used, one having the relatively unyielding disc, and the other, the relatively yielding disc.

Another object of this invention is to provide apparatus which can be accurately adjusted to position the axis of the lens at a desired angle without disturbing the adjustment of the level of the lens relative to the plane of the disc. For this purpose, the angularity adjustment is accomplished with respect to a pivot axis that is appropriately tangent to the edge of the lens at a point on the lens addressed to the disc.

Another object of this invention is to provide a unique hood that surrounds the work and not only collects and returns to a reservoir the fluid polishing compound, but also serves conveniently for lifting the work from the disc and exposing it for manipulation by the technician.

Another object of this invention is to provide a compact machine for imparting the required rotary and translational motions to a lens while yet permitting the requisite adjustments.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming a part of the present specification, and which drawings, unless described as diagrammatic, or unless as otherwise indicated, are true scale. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of an edge finishing machine incorporating the present invention;

FIG. 2 is a sectional view taken along the plane corresponding to lines **2—2** of FIG. 1.

FIGS. 3 and 4 are enlarged fragmentary sectional views taken along planes corresponding to lines **3—3** and **4—4** of FIG. 1;

FIGS. 5, 6 and 7 are diagrammatic views illustrating the manner in which the edge of the contact lens is finished by the machine; and

FIG. 8 is a sectional view of a substitute disc for use with the machine.

DETAILED DESCRIPTION

The contact lens is edge finished by the aid of two discs or rotors **10** (FIGS. 1–3) and **12** (FIG. 8). Both rotors have provisions (not shown) for detachable coupling to a shaft **16** (FIG. 2) that projects through an aperture in a deck **18** of a housing structure **20**. A motor **22** suspended beneath the deck drives the shaft **16**.

The rotor **10** has a thin cover **24** (FIG. 3) detachably

secured to it by the aid of an elastic band **26**. This cover may be made of velveteen, chamois, felt or the like. Thus, the downwardly turned marginal edges of the cover **24** are caught between the band **26** and a peripheral groove **28** on the disc. A slight amount of padding may be provided beneath the cover **24**. Due to the characteristics of the cover **24** and the padding, a substantial grinding pressure may be developed.

The disc **12** is similar, except that its pad **32** (FIG. 8) is made of sponge or foam rubber or other material having similar yielding and resilient characteristics. Hence, the pad produces delicate grinding pressures.

The lens L shown in FIG. 5 has previously been ground to provide the appropriate anterior and posterior curvature according to prescription. Sharp anterior and posterior peripheral edges *a* and *b* remain. The desired configuration is illustrated in FIG. 7 where both the anterior and posterior edges have been substantially rounded, as at *a'* and *b'*. A substantial amount of material must be removed (FIG. 6) in order to produce the rounded anterior bevel *a'* (FIG. 7). However, only a slight amount need be removed from the posterior edge. The disc **10** with its relatively unyielding cover serves the purpose of shaping and rounding the anterior edge *a* while the softer disc **12** serves the purpose of rounding the posterior edge *b*. In practice, two identical machines may be provided, one having the rotor **10** and the other having the rotor **12**. However, if desired, the same machine may be used by interchanging the discs **10** and **12** for the appropriate operations.

In order to reduce the edge *a* to the rounded configuration *a'*, the anterior surface of the lens L is appropriately addressed to the cover **24**, while a polishing or grinding compound is applied thereto and the rotor **10** and the lens L rotate about their respective axes. At the same time, the lens L traverses across the face of the cover **24**, passing close to, but preferably a slight distance from, the center of the disc.

The lens L is supported on a traverse mechanism that not only imparts the desired motion to the lens but which also holds the lens in a suitably adjusted position while allowing the lens to be lifted temporarily without disturbing the adjustment. The lens L is held so that its axis *x* asumes the desired angular relationship with the plane of the disc **10** and so that the edge of the lens is at a desired controlled elevation relative to the cover **24** or pad, as the case may be.

The traverse mechanism includes a base plate **34** (FIGS. 1 and 2) supported above the deck **18** by the aid of a bearing pin **36** (FIG. 2) located laterally beyond the disc **10** to **12**. The bearing pin **36** is installed at an aperture **38** of the decking **18**. The pin **36** has a spacer flange **40** that overlies the deck and engages beneath the plate **34** and about its aperture **42**. Flanges **44** and **46** hold the parts against relative axial movement.

A bar **48** is attached to the plate **34** and mounts, at its respective ends, journal brackets **50** and **52** (see also FIG. 1). A rocker **54** is pivoted on the brackets **50** and **52** by the aid of a shaft **56**. The rocker includes parallel arms **58** and **60** attached to the projecting ends of the shaft **56**. The arms **58** and **60** are held in angular alignment and parallelism by the aid of a cross brace **62** (FIGS. 2 and 3). The arms **58** and **60** project on opposite sides of the rotor **10** or **12** to points located substantially diametrically thereof. Pins **63** and **64**, projecting inwardly toward the rotor **10** or **12**, pivotally mounts arms **66** and **68** of a U-shaped bracket **70**. This bracket is swingable between the rocker arms. A hollow shaft **72** (FIG. 3) is mounted at one end by the connecting portion **73** of the bracket **70** for rotation about its axis. The hollow shaft **72** extends substantially parallel to the bracket arms **66** and **68**. A vacuum gripper in the form of a flexible tube **74** is telescoped over the free other end of the hollow shaft **72**, and serves, upon application of negative pneumatic pressure, to hold the lens L. The parts are so proportioned that the axis of the pins **63** and **64** about which the bracket **70** moves is tangent to the edge of the lens L at its lowermost portion.

By rotating the rocker **54** and its arms **58** and **60** about the axis of the shaft **56**, the lens edge is elevated or lowered to make suitable contact with the covering **24** or the flexible pad **32**, as the case may be. To accomplish this purpose, a screw **76** (FIG. 4) is provided. This screw is threadedly accommodated in a block **78** attached to the under surface at one end of the brace **62**. The end of the screw is positioned to engage the side of the bar **48**. Accordingly, upon rotation of the screw **76**, the desired adjustment is achieved.

By rotating the bracket **70** about the axis of the pins **62** and **64**, the angular inclination of the axis *x* relative to the plane of the disc **10** is adjusted. This adjustment is necessary in order to compensate for different curvatures of the various lenses.

A screw **80** (FIGS. 2 and 3), threadedly accommodated in one of the arms **66**, engages the bar **62** of the rocket **54** and thus achieves the desired adjustment.

In order to cause traversing movement of the lens L across the face of the disc **10** or **12**, an accentric drive is provided for the plate **34**. Thus the plate **34** has a rearwardly projecting slotted part **82** (FIG. 17) that cooperates with a pin **84** (FIG. 2) eccentrically mounted upon a shaft **86** of a drive motor **88** mounted beneath the deck **18**.

The hollow shaft **72** (FIG. 3) projects rearwardly through the central connecting portion **73** of the bracket **70**. A sleeve or fitting **90** carries a gear **92** by the aid of which rotation is imparted to the shaft **72**. The fitting **90** also has a slip-fit connection with a vacuum hose **94**, whereby the negative pressure may be applied. The vacuum hose **94** passes through a clearance aperture **96** in the deck **18** (FIG. 2) and connects with a vacuum fitting **98** of a pneumatic pump **100**. Pump **100** is mounted upon a bracket **102** fastened to the lower wall **104** of the casing **20**.

A drive gear **106** (FIG. 1), mounted upon the connecting portion **73**, is driven by a flexible shaft **108** that extends through a clearance aperture **110**. A motor **112** mounted beneath the deck operates the flexible shaft.

In order to supply suitable fluid-suspended abrasive material, a flexible conduit **113** is provided. This conduit **113** connects to a reservoir **114** (FIG. 2). A discharge nozzle **116** mounted upon the bracket **70** is fed by the conduit **113**.

The reservoir **114** is pressurized by the pneumatic pump **100**. Thus its pressure fitting **116** cooperates with conduits **118** and **120** that connect with the reservoir **114**. A control valve **122** interposed between the conduits is mounted upon the slanting front panel **124** of the housing and adjusts the pressure and the rate of feed of polishing or grinding compound. The valve **122** is adjusted by a knob **126**. A vacuum gauge **128**, also mounted upon the panel, connects to the vacuum fitting **98** via a hose **130**. The polishing compound in the reservoir is replenished through a filler cap **132** that projects through the deck **18**.

The pneumatic pump **100** is operated by a motor **134** also attached to the bracket **102**. In order to control the motors **112**, **134**, **22** and **88**, switches **136**, **138**, **140** and **142** are provided on the front panel **124**.

In order to prevent a splashing of the polishing compound and in order to elevate the rocker **54**, a transparent hemispherical hood **144** is provided. This hood **144** substantially encompasses the disc **10** or **12**, and extends between the arms **66** and **68** of the bracket **70**. It has apertures cooperable with the inner ends of the pins **63** and **64** whereby the hood **144** is pivotally mounted. The edge of the hood is turned inwardly to form a channel **146** that collects the fluid polishing compound. A conduit **148** returns the collected fluid to the reservoir **114** or to another collection sump.

The hood **144** has a suitable access opening **150** for passage of the hollow shaft **72** and the nozzle **74**. Normally the hood opening is substantially horizontal and spaced from the deck **18**. However, by lifting the front of the cover, the cover tilts to the position shown in full lines in FIGS. 2 and 3 in which the rear portion contacts the deck **18**. Upon further angular movement of the hood **144**, the pins **63** and **64** are elevated, the deck contacting portion of the hood acting as a fulcrum. The bracket **70** and the associated mechanisms are thus carried upwardly. Access is accordingly provided for the operator to remove or replace the lens L at the flexible sleeve **74**. When the hood **144** is elevated, the end of the screw **76** (FIG. 4) simply separates from the bar **56**. When the hood **144** is released, the parts return to the operative position illustrated in FIGS. 2 and 3 and as determined by the setting of the screw **76**.

A timer **152** mounted on the front panel normally determines the period required for rounding of the anterior or posterior edges *a* and *b*. The screw **80** is set to a position determined by the prescribed curvature of the lens L. Replacement lenses can be exactly reproduced. A gauge **154** (FIG. 3) indicates the angularity of the bracket **70**.

The finishing of the posterior edge is begun after the anterior edge is finished sufficiently to sharpen the posterior edge to a fine edge as indicated in FIG. 6. This may be detected by visual instrument inspection and/or by noting a reduction in lens diameter with a taper gauge. The location of the posterior bevel *b'* relative to contact surface of the lens depends upon the angularity of the holder. By shifting the angle, the grinding effort is proportioned between the opposite sides of the lens as the lens traverses on opposite sides of the rotor axis.

Adjustment of the lens holder being relative to the disc, obviously the disc itself could instead be mounted for traverse and for adjustment of its elevation and angularity.

The inventor claims:

1. In apparatus for finishing the anterior and/or posterior edges of contact lenses, or the like: a disc rotatable about an axis; a traverse mechanism; a lens holder mounted on the traverse mechanism to address the anterior or posterior side of the lens to the disc; means rotating the holder about an axis inclined to the disc and corresponding to the axis of the lens; said lens axis defining a plane perpendicular to said disc and passing through said lens axis; and means imparting traversing motion to the traverse mechanism to cause the said plane to move laterally and on opposite sides of said disc axis whereby the lens sweeps across said rotary disc from one zone in which the disc moves in one direction relative to the lens to the other zone in which the disc moves in the other direction relative to the lens.

2. In apparatus for finishing the anterior and/or posterior edges of contact lenses, or the like: a rotary disc; a traverse mechanism; a lens holder mounted on the traverse mechanism to address the anterior or posterior side of the lens to the disc; means rotating the holder about an axis corresponding to the axis of the lens; and means imparting traversing motion to the traverse mechanism to cause the lens to sweep across said rotary disc from one zone in which the disc moves in one direction relative to the lens holder to the other zone in which the disc moves in the other direction relative to the lens holder with the lens substantially aligned with the direction of traverse; said lens holder including a rigid hollow shaft, a flexible tube mounted on the end of the shaft and forming an extension thereof to provide a conformable seat for a curved lens, and means to apply a negative pressure to said shaft during its rotation by said rotating means.

3. The apparatus as set forth in claim **1** in which said traverse mechanism includes means adjustably to determine the angle of inclination of said axis of rotation of said holder relative to the plane of said disc.

4. In apparatus for finishing the anterior and/or posterior edges of contact lenses, or the like: a rotary disc; a traverse mechanism; a lens holder mounted on the traverse mechanism to address the anterior or posterior side of the lens to the disc; means rotating the holder about an axis corresponding to the axis of the lens; means imparting traversing motion to the traverse mechanism to cause the lens to sweep across said rotary disc from one zone in which the disc moves in one direction relative to the lens holder to the other zone in which the disc moves in the other direction relative to the lens holder with the lens substantially aligned with the direction of traverse; said traverse mechanism including means adjustably to determine the angle of inclination of said axis of rotation of said holder relative to the plane of said disc; and means mounting said holder on said traverse mechanism for adjustment about an axis located substantially in the plane of said disc and passing substantially through the area of contact of said lens with said disc substantially in the direction of traverse whereby the angle of inclination of the axis of rotation of said holder is adjusted without altering the vertical location of said lens relative to said disc.

5. The apparatus as set forth in claim **1** in which said traverse mechanism has a first part mounted for swinging or traverse movement and a second part mounted on the first part and in which said holder is mounted, said second part being adjustable on the first part to elevate and lower the lens holder relative to the plane of said disc.

6. The apparatus as set forth in claim **1** in which the traverse mechanism includes a rocker pivotally mounted about an axis located in a plane substantially perpendicular to the axis of rotation of said disc, and laterally spaced therefrom; said mechanism further including a bracket pivotally mounted on the rocker for movement about an axis that extends in a plane substantially perpendicular to the axis of rotation of said disc, said holder being mounted on said bracket to position the disc contacting point of the lens edge to be substantially coincident with the said axis of mounting of said bracket, angular positioning of said bracket about its said axis serving adjustably to determine the angle of inclination of said axis of rotation of said lens holder relative to the plane of said disc, while angular positioning of said rocker about it axis serves adjustably to determine the elevation of said lens holder relative to the plane of said disc.

7. The combination as set forth in claim **5** together with screw-threaded stop means for limiting movement of said second part relative to said first part in a direction toward said disc to determine the elevation of said lens holder; said second traverse mechanism part being biased toward said stop means whereby said second part can be lifted away from said stop means without changing the elevation adjustment.

8. The apparatus as set forth in claim **4** in which said traverse mechanism has a first part mounted for swinging or traverse movement and a second part mounted on the first part and in which said holder is mounted, said second part being adjustable on the first part to elevate and lower the lens holder relative to the plane of said disc.

9. The combination as set forth in claim **8** together with screw-threaded stop means for limiting movement of said second part relative to said first part in a direction toward said disc to determine the elevation of said lens holder; said second traverse mechanism part being biased toward said stop means whereby said second part can be lifted away from said stop means without changing the elevation adjustment.

10. In apparatus for finishing the anterior and/or posterior edges of contact lenses, or the like: a disc rotatable about an axis; a traverse mechanism movable in a plane parallel to the plane of the disc; a lens holder mounted on said traverse mechanism to address the anterior or

posterior side of the lens to the disc; means rotating the holder about an axis corresponding to the axis of the lens; means angularly adjusting the lens holder on said mechanism about an axis located perpendicular to the plane defined by said lens axis and said disc axis and passing through the region of contact of said lens with said disc for adjusting the angle of inclination of said lens to said disc without changing the elevation of said lens relative to said disc.

11. The apparatus as set forth in claim **10** in which said traverse mechanism includes one part mounted for traverse movement and a second part mounted on said first part, said lens holder being mounted on said second part; said second part being pivotally mounted on said first part for adjusting the elevation of said lens holder relative to said disc; screw-threaded stop means limiting the movement of said second part on said first part for determining the elevation of said lens holder; said second part being biased toward said screw-threaded stop means.

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U.S. Cl. X.R.

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