Sept. 14, 1965 P. F. THOMAS 3,205,625

GRINDING OF CONTACT LENSES

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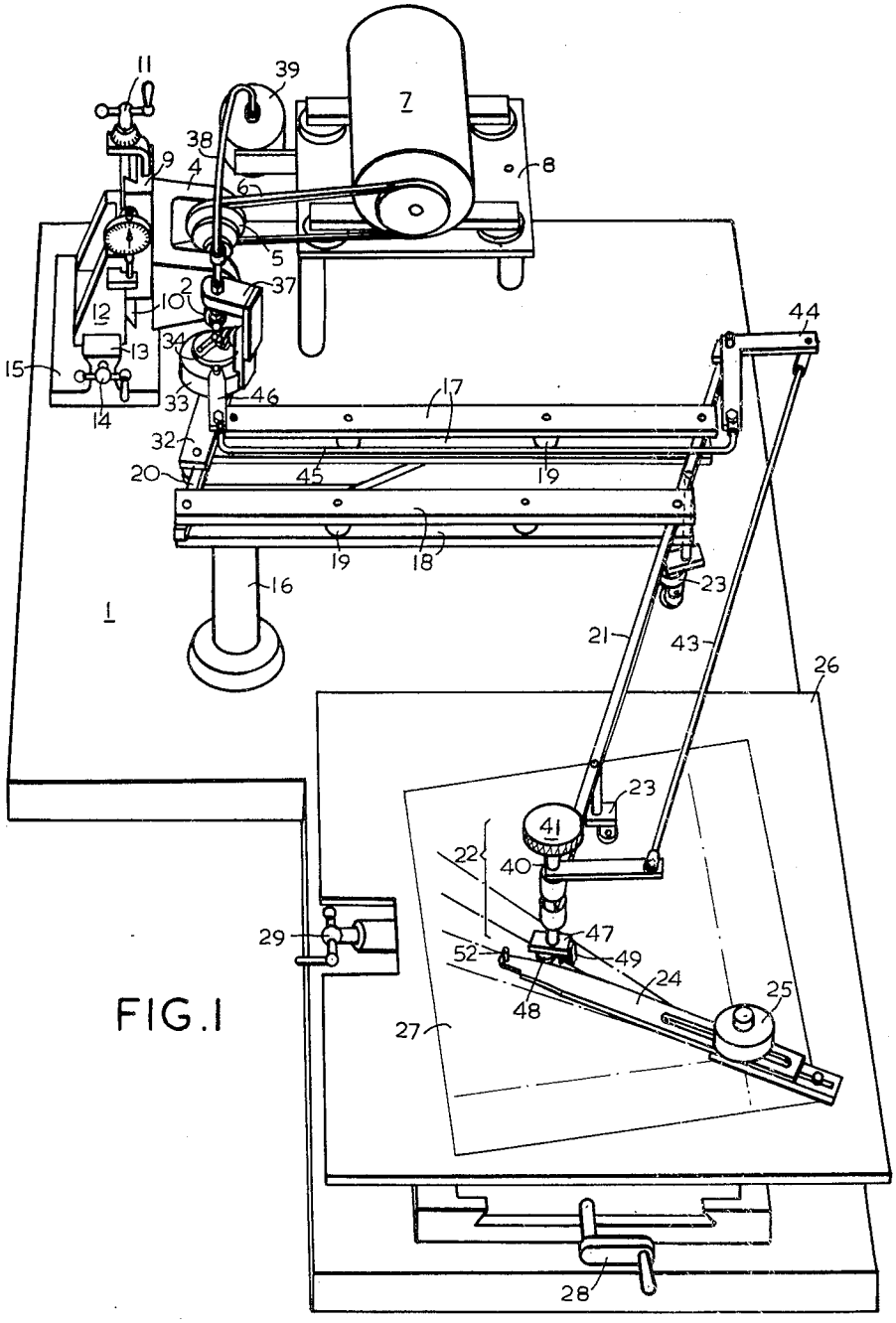


FIG. 1

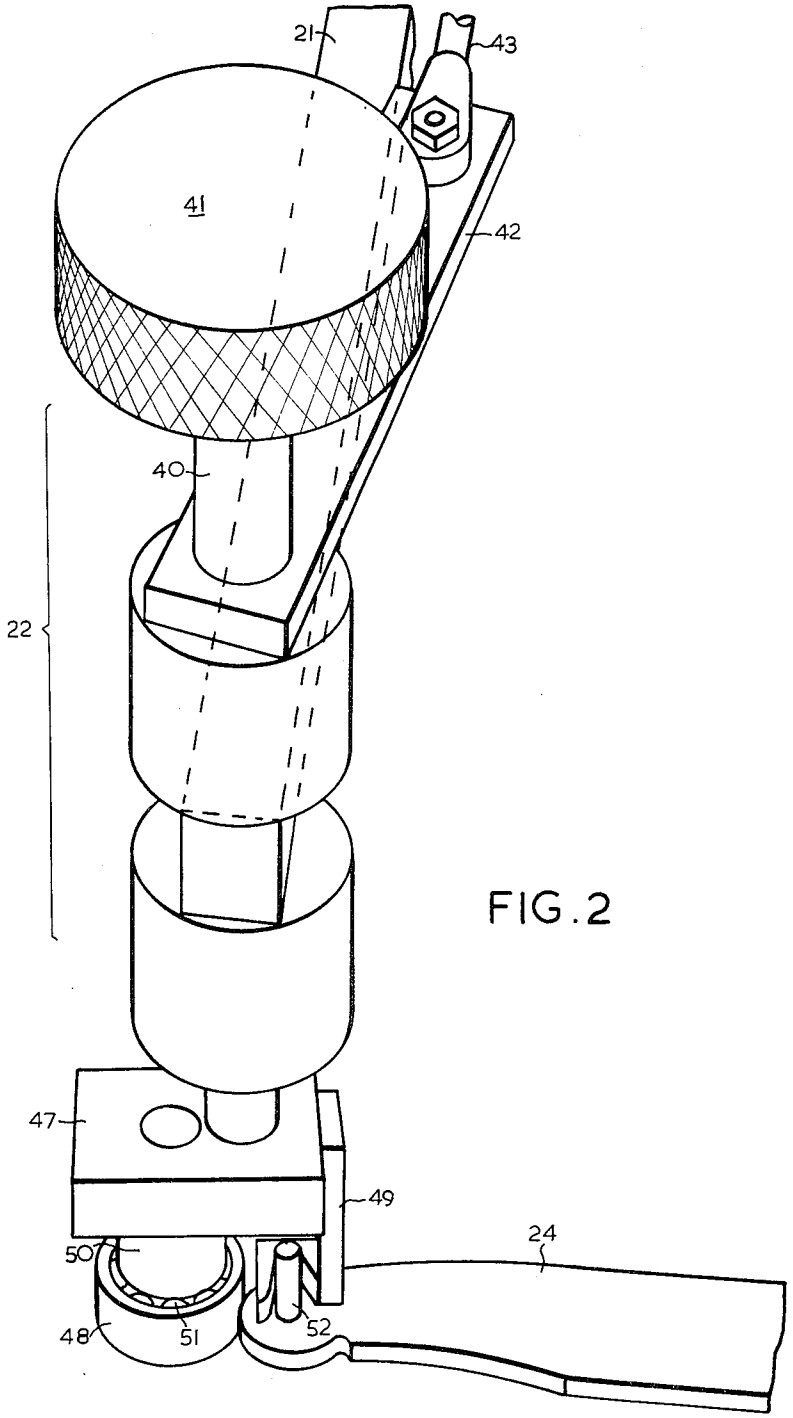


FIG. 2

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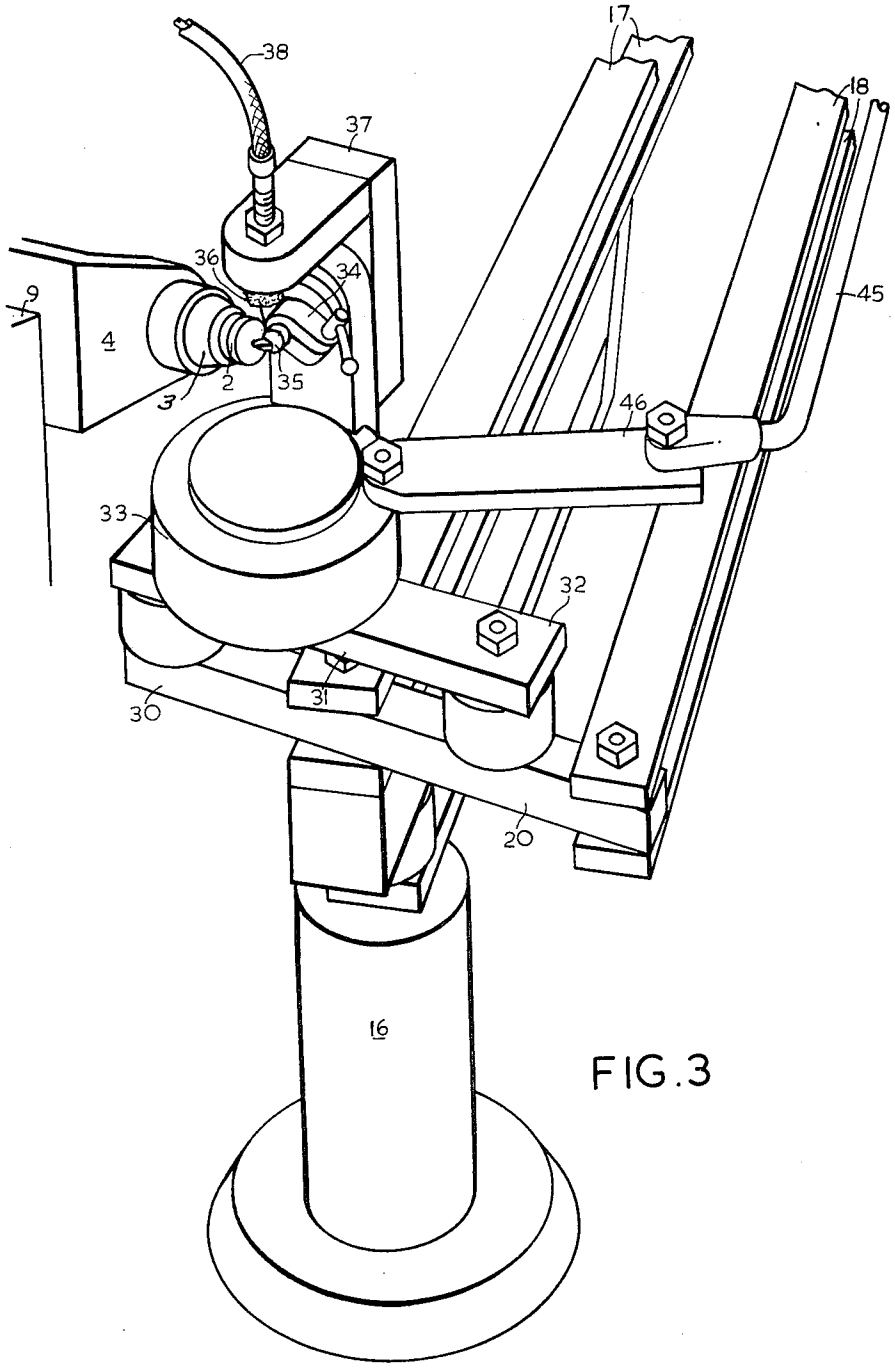


FIG. 3

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GRINDING OF CONTACT LENSES

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4 Claims. (Cl. 51—284)

The invention relates to the grinding of contact lenses and more specifically to the grinding of the secondary curves on such lenses sometimes referred to as the "limbal band."

Contact lenses, which are designed to fit on the cornea of the human eye, consist generally of an inner part which constitutes the optic and is ground to the required power and an outer part, the limbal band, which is composed of a number of so-called secondary curves, of greater radius than the optic and designed to fit the cornea of the wearer.

While the secondary curves are ground on the concave side of the lens it is also necessary to grind the convex side of the lens outside the actual optic to maintain a predetermined thickness of the lens on its periphery. In addition, the outer part has to be ground in such a way that its centre plane forms a predetermined angle with a tangential plane through the apex of the optic.

This angle is dependent, in the same way as the limbal band, on the shape of the cornea to which the lens is to be applied.

In the past grinding of the individual secondary curves was carried out by separate grinding operations and a further operation was required to shape the lens periphery.

This manufacturing method not only necessitates a substantial number of individual grinding operations, but makes it rather difficult to reproduce exactly the same limbal band when grinding a plurality of lenses as minor variations in the individual grinding operations are unavoidable. Furthermore, sharp ridges will appear where two curves of the limbal band meet each other and these ridges have to be removed by further grinding.

The beforementioned disadvantages are overcome according to the invention by a method for grinding lenses comprising the steps of mounting the lens to be ground on a rotatable support, adjusting the support to bring the lens in contact with a grinding tool and moving the grinding tool over the lens surface by means of a pantograph device and controlling the movement of the pantograph device from a template representing an enlarged replica of the periphery and the cross-sectional curves of the lens.

In one form of the invention the lens is positioned in a rotating holder in any known manner. The grinding tool support is fixed to the free arm of a pantograph which is so arranged that the grinding head can pass from one side of the lens periphery to the other side.

The guiding or tracer arm of the pantograph carries a tracer head which is guided by a template giving an exact replica of a cross-section through the required outer part of the lens including the various secondary curves. The template can be made on a much larger scale than the actual lens curve, as the pantograph will automatically reduce the movement of the grinding head to any desired degree, thus a great accuracy in grinding can be achieved. In one grinding operation the periphery of the lens can be shaped and brought down to the required thickness and the various secondary curves forming the limbal band are ground in the same operation. As the tracer pin moves from one curve to the other without interruption any sharp ridges between adjoining curves are eliminated.

One embodiment of the invention is described hereinafter in connection with the drawings in which:

FIGURE 1 shows a perspective view of the apparatus according to the invention;

FIGURE 2 shows the tracer head, its mounting and part of the template of FIGURE 1 on an enlarged scale;

FIGURE 3 shows the grinding head of FIGURE 1 and its mountings on an enlarged scale.

As shown in FIGURE 1 the apparatus has a base plate 1 which supports all the various parts referred to hereinafter.

The concavo-convex lens to be ground is fitted on a lens holder 2 secured in suitable manner in a shaft 3 supported by a head stock 4. Pulleys 5 are fixed on shaft 3 and are driven by a belt 6 from an electric motor 7 mounted on a support 8 secured to the base 1. The head stock 4 is secured on a saddle 9 which slides on a vertical slide 10 and is adjustable in its position by means of a spindle 11. The slide 10 forms part of a bracket 12, which in turn is adjustably mounted on the bracket slide 13 for horizontal movement thereon by means of spindle 14. The bracket slide 13 forms an integral part with a bed plate 15 secured to the base plate 1.

A pantograph mechanism is rotatably supported on the base plate 1 by a column 16. This mechanism consists basically of two pairs of bars 17, 18, the bars of each pair being spaced from each other by spacers 19. On one side the end of the bar pairs are linked with each other by a crosspiece 20 rotatably connected thereto while the other ends of the bar pairs are rotatably linked by a guiding or tracer arm 21 which carries at its extended end the tracer head 22. To increase stability the tracer arm 21 is guided over the base plate 1 by means of casters 23.

The tracer head 22, which will be described in more detail later on, is guided, for example, manually along a template 24 representing the required curves of the lens, and the template is clamped by a clamping device 25 to a horizontal table 26 which can carry the necessary scales or graduations 27 for setting the template to the required position. The table 26 is movable in two directions at right angles to each other in relation to the base plate 1 by means of spindles 28 and 29.

As mentioned above, the pantograph is rotatably mounted on the column 16. A pivot on column 16 engages the pair of bars 17 at a point slightly inwards from the linkage point 31 of bars 17 with the cross piece 20 as shown in FIGURE 3. In a practical example the pivot point is arranged about ½" from the ends of bars 17. The cross piece 20 is extended beyond the bars 17 as shown at 30 and the linkage point 31 is bridged by a bridge 32 which carries a disc 33 rotatably mounted thereon. The centre of the disc 33 is offset from the linkage point 31 in the direction of extension 30 of cross piece 20. A tool holder 34 is fixed to the disc and a grinding head 35, for example, a diamond head, is mounted in the tool holder 34 in such a manner that its tip lies in the vertical axis through the centre of the disc and the grinding head itself swings around this axis on rotation of the disc.

If required a polishing buff 36 can also be mounted by means of bracket 37 on the tool holder 34 so that its axis of rotation lies in the vertical axis through the disc centre. The buff 36 is driven, for example, by a flexible shaft 38, from an electromotor 39 (FIGURE 1), suitably mounted on the support 8.

The disc 33 is connected by a linkage with the tracer head 22 to be rotated thereby as will be described hereinafter. The tracer head 22 has a shaft 40 with a knurled knob 41. Fixed to the shaft 40 is a lever 42, which is

linked at its free end to a rod 43. The other end of rod 43 is pivoted at one arm of a bell crank lever 44 which is mounted on the extended end of the tracer arm 21. The other arm of the bell crank lever 44 is linked with a rod 45 which in turn connects over the link 46 with the disc 33. Thus any rotation of the shaft 40 will be transmitted over the linkage to impart a corresponding angular movement of the disc 33 with its toolholder 34.

The lower end of the shaft 40 is fixed in a mounting block 47 (FIGURE 2) which carries a guide roller 48 and a hook-shaped extension or catch 49. The guide roller 48 is rotatable on a stub axle 50 by means of a ball bearing 51 and the stub axle is offset in relation to the shaft axis so that the latter is tangential to the periphery of the roller 48.

The catch 49 fixed on the mounting plate 47 rides over the template 24 when the guide roller 48 rolls along the edge of the template. The end of the template 24 corresponds to the periphery of the lens to be ground and carries a pin 52. When on movement of the tracer head 22 along the template 21 the catch 49 engages the pin 52 the latter acts as a fulcrum to swing the mounting block 47 around the end of template 24 thus imparting a rotating movement to the shaft 40. This shaft in turn transmits its angular movement over the linkage 42, 43, 44, 45 and 46 to the disc 33 and thus to the grinding head 35, which grinds the periphery of the lens on lens holder 2 corresponding to the curve at the end of template 24.

By appropriate dimensioning the various parts of the pantograph in known manner a high ratio of, for example, 40:1 between the movements of the tracer head 22 and the grinding head 35 can be provided, permitting an accuracy in the grinding of contact lenses not achieved hitherto. In addition the required curves can be exactly reproduced as often as required.

Although the invention has been described above primarily for the grinding of secondary curves of contact lenses the same apparatus can be used by proper shaping of the template to grind the required power. Thus, the whole inside of the lens including optic and limbal bands and the periphery can be ground in one continuous operation.

In the same way it is also possible to grind the outside or convex side of a contact lens using a corresponding template.

I claim:

1. In a method of manufacturing from a blank, a concavo-convex contact lens fitting the cornea of a user, said lens having a central optic and a limbal band, the steps of rotating said blank about a fixed axis, grinding the side of said rotating blank which will form the concave side of said lens to form at least said limbal band, grinding said rotating blank outside of the limbal band to form the periphery of said lens, and grinding a portion of the side of said rotating blank which will form the convex side of said lens, said last-mentioned portion being adjacent said periphery, said grinding steps being performed in the order recited and in an uninterrupted, continuous and guided manner.

2. In a method of manufacturing from a blank, a concavo-convex contact lens fitting the cornea of a user, said lens having a central optic and a limbal band, the steps of rotating said blank about a fixed axis, grinding the side of said rotating blank which will form the concave side of said lens to form said central optic and said limbal band, grinding said rotating blank outside of the limbal band to form the periphery of said lens, and grinding a portion of the side of said rotating blank which will form the convex side of said lens, said last-mentioned portion being adjacent said periphery, said grinding steps being performed in the order recited and in an uninterrupted, continuous and guided manner.

3. In a method of manufacturing from a blank, a concavo-convex contact lens in accordance with claim 2 which includes the step of polishing the ground concave side and the periphery of said rotating blank.

4. The method of manufacturing from a blank, a concavo-convex contact lens in accordance with claim 2 which includes the step of grinding the unground convex portion of the rotating blank in a guided manner to form said lens.

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