Sept. 11, 1945. H. L. PENBERTHY 2,384,638

METHOD OF FORMING LENS SURFACE

Filed Oct. 4, 1943

FIG. 1.

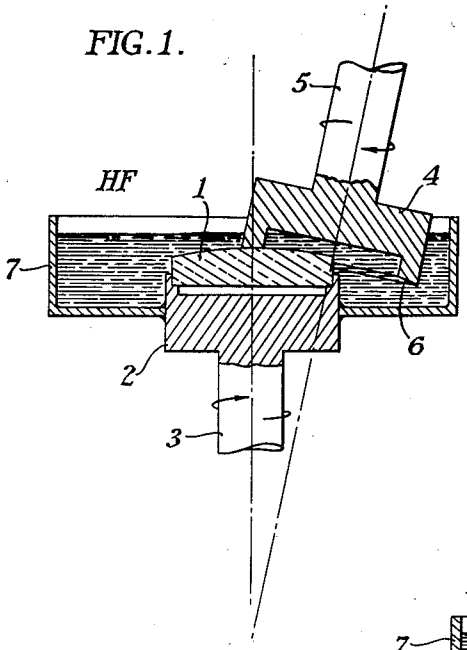


FIG. 2.

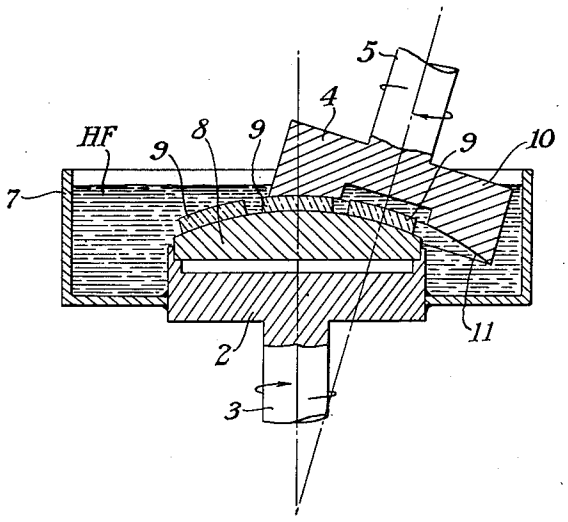
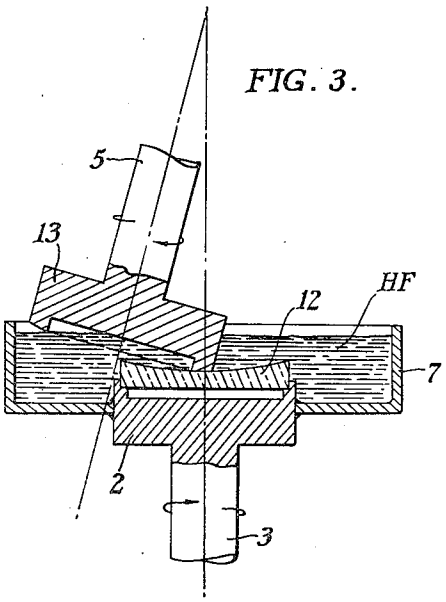


FIG. 3.



HARVEY LARRY PENBERTHY
INVENTOR

BY Newton M. Perrins
ATTORNEY

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METHOD OF FORMING LENS SURFACES

Harvey Larry Penberthy, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y., a corporation of New Jersey

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2 Claims. (Cl. 41—42)

This invention relates to the shaping of lens surfaces. Such surfaces are ordinarily formed by molding or grinding, the most common method being molding to a very rough approximation of the desired shape and then grinding, followed by polishing of the surface, the polishing usually being with pitch and rouge.

In some cases "acid polishing" is used to attain the final surface effect, this comprising treatment with hydrofluoric acid. Acid polishing, however, is used merely to attain the desired finish, and the hydrofluoric acid treatment has not been used to shape the lens surface to the desired curvature. In the patent Correll, 1,430,494, granted September 26, 1922, it is stated that hydrofluoric acid may be used to give a satin-like sheen and that it may be used in conjunction with carborundum or other fine powder to enhance the effect. The acid is, in no instance, however, used as the primary means for attacking or removing the substance of the glass under conditions so controlled as to shape the surface to the desired curvature.

I have found that if the hydrofluoric acid is applied to the surface of the glass blank in controlled amount, and at the same time the surface is rubbed with a non-abrasive curve generator which merely removes the products of the acid treatment, the glass will assume the same spherical shape that it would if no acid were used and the curve generator had the usual abrasive surface. The action of the curve generator is to remove the products of the acid attack from the high points, leaving them open to further attack, while the unremoved products at low points in the surface partially protect these points from further attack. The action thus proceeds until the whole surface has assumed the spherical form of the curvature for which the curve generator is set.

For clearness of description reference will now be made to the accompanying drawing wherein:

Fig. 1 shows diagrammatically a curve generator used with a single convex lens blank;

Fig. 2 shows similarly a curve generator used with a blocking body holding a multiplicity of convex lenses;

Fig. 3 shows similarly a curve generator used with a single concave lens, it being understood that the blocking body may hold a multiplicity of concave lenses.

In Fig. 1 a lens blank 1, which in this instance has previously been roughly molded with one surface convex, is mounted on a support 2 carried by the rotatable shaft 3. A water-tight basin 7 surrounds the support 2 and is rotatable with it. A cup-shaped element 4, shown in section, having a rim 6 similar in form to known curve generators in which the face of the rim is of abrasive material is carried by rotatable shaft 5, the angle of the latter being adjustable as in known lens grinding machines in which the curvature of the ground surface is determined chiefly by the angular position of the shaft 5. In the present case, however, the rim is of a material which is not abrasive to glass in the sense that diamond and corundum are and yet is hard enough to remove the products of the acid attack. Plastics of known cellulose acetate compositions, methacrylate resins, ureaformaldehyde condensation products, pitch, hard rubber, lead, copper, brass, Monel metal and analogous known materials may be used. These materials may or may not be corrodible by hydrofluoric acid. If the material is slightly corrodible by the acid, a smoother lens surface is obtained; if not corrodible, the cup has a longer life.

In operation, a lens blank is fastened in place on the lower shaft 3, and hydrofluoric acid, HF, is poured into the basin 7. The two rotatable shafts, 3 and 5, are then set in motion, being rotated in opposite directions, and one of them, usually 3, is advanced along its axis until the revolving cup contacts the revolving lens. The contact is maintained by moderate pressure until all of the high spots of the lens are corroded away, as described above. Most of the acid is then removed, and water is added while the machine is still operating. The then dilute acid continues to attack the glass, but at a much slower rate, helping to obtain an even surface. The dilution may be continued until the chemical action ceases. Alternatively, the action can be stopped at once by the addition of an alkali. The machine is then stopped and the lens removed. The lens surface thus prepared is sufficiently smooth and spherical for many applications, such as cementing to another lens or use as a condensing lens. If high accuracy is desired, a small amount of additional polishing by usual optical methods will produce the perfection required. It is to be understood that the acid may be applied to the surfaces by other means than immersion.

In Fig. 2 the parts are the same as in Fig. 1, where the same reference characters are used, but instead of carrying a single lens the support 2 carries a blocking body 8 holding a plurality of lens blanks 9, and the cup wheel 10 has wide rims 11.

The cup wheels 4 and 10 are shown without ser-

rated rims; but with certain glasses, such as dense barium crowns, the products of the acid attack are so insoluble and tenacious that such products are more easily removed if teeth, radial or otherwise, are cut in the rim of the cup wheel, as in the manner of a trepanning saw. Further, easier operation is obtained with a multiplicity of lenses 9 if the width of the rim of the wheel is greater, as in 11 of Fig. 2 compared with 6 of Fig. 1. In fact, the wheel need not have any hole in the center at all, although experience shows that very little, if anything, is gained thereby.

In Fig. 3, also, like characters designate like parts, but in this case the single lens 12 shown is concave, and the position and shape of the cup wheel 13 are adapted to form the desired concave surface. It is understood that a concave blocking body carrying several lens blanks could also be used.

As described above, the acid attacks the glass with the formation of products which, adhering to the glass, inhibit the further attack of the acid unless they are removed, as by the action of the cup wheel upon high spots on the lens blank. This inhibiting action can be extended to the point of being an actual resist by coating the lens, before surfacing, with wax, lacquer, or a similar substance which prevents action of the acid but which will be removed locally by the rotating cup wheel when the wheel comes in contact with said substance.

The foregoing describes only the use of hydrofluoric acid and water, and in general this is sufficient. However, the fluorides of some of the elements used in certain glasses are very hard to remove. In such cases it is better to add other chemical reagents to the hydrofluoric acid to change the products of the attack of the glass and hence their physical properties. Many chemical reagents, such as nitric acid, sulfuric acid, phosphoric acid, hydrochloric acid, perchloric acid, acetic acid, potassium dichromate, sodium chloride, sodium nitrate, and so forth, can be used to accomplish the same result. Further, plain nitric acid or sulfuric acid alone works very well with certain glasses such as very dense barium glasses having a low silicate content and the non-silicate glasses described in the patents, Eberlin 2,206,081 and Eberlin and De Paolis 2,241,249. These few instances by no means exhaust the possibilities of making changes in the chemical constitution of the corrosive bath and should not be construed as limitations of the method itself.

Having thus described my invention, what I claim is:

1. The method of forming a lens surface of desired curvature from a rough glass blank that comprises coating the surface with a resist, applying to the surface of the blank a chemical which attacks glass but does not penetrate the resist, rotating the blank in contact with a rotating non-abrasive surface having a position and shape conforming to the desired lens surface, whereby the non-abrasive surface wears away the resist from protuberances in the glass surface, thus permitting access of the chemical to the glass, and also removes the products of the action of the chemical upon the glass, and continuing the application of chemical and rotating of the said surfaces in contact until the resist is entirely removed and the glass surface has attained the desired curvature.

2. The method of forming a lens surface of desired curvature from a rough glass blank that comprises coating the surface with a material that is resistant to hydrofluoric acid, applying hydrofluoric acid to the coated surface and at the same time rotating the blank in contact with a rotating non-abrasive surface having a position and shape conforming to the desired curvature, whereby the non-abrasive surface first wears away the resist from protuberances in the glass surface, thus permitting access of the acid to the glass, and also removes, as it forms, the products of the action of the acid upon the glass, and continuing the application of hydrofluoric acid and the rotation of the surfaces in contact until the resist is entirely removed and the glass surface has attained the desired curvature.

HARVEY LARRY PENBERTHY.