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LENS SURFACING TECHNIQUES

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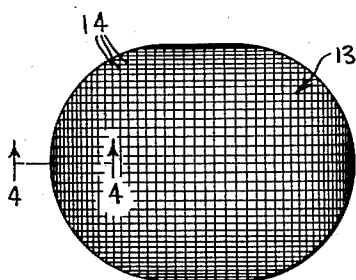


Fig. 1

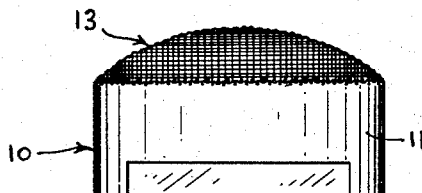


Fig. 2

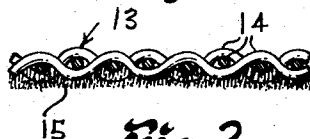


Fig. 3

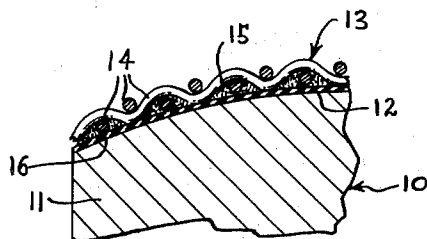


Fig. 4

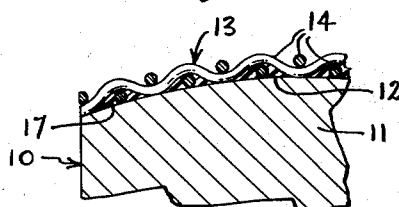


Fig. 5

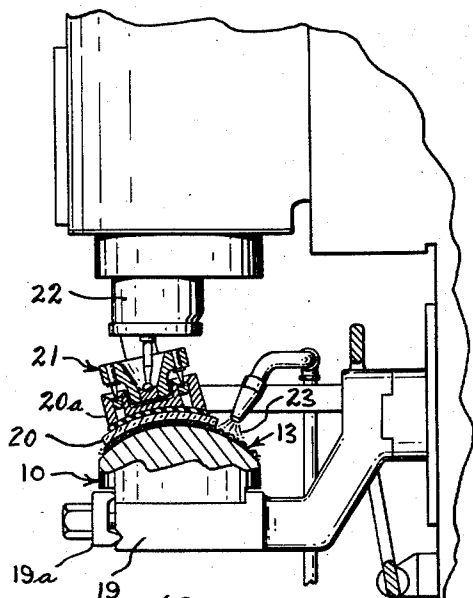


Fig. 7

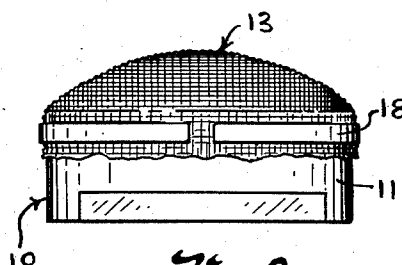


Fig. 6

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LENS SURFACING TECHNIQUES

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10 Claims. (Cl. 51—185)

This invention relates to improvements in abrading apparatus and has particular reference to the provision of an improved lens abrading tool and method of making the same.

In general, prescriptive curvatures are applied to ophthalmic lens blanks by rough grinding or generating the approximate desired curvature on a particular side thereof, fine grinding said side to the precise curvature desired and thereafter polishing the fine ground side to a high degree of optical perfection. The fine grinding or fining operation is most commonly accomplished by placing the surface of the lens blank in contact with a cast iron surfacing tool having a surface curvature thereon which is precisely formed to the desired curvature to be reproduced upon said lens blank and thereafter applying a slurry containing abrasive particles of a selected size to said tool surface while introducing a controlled pressure and oscillatory motion to either or both the tool and lens blank so as to cause the abrasive particles to abrade the surface of the blank and thus cause said surface to eventually assume the shape of the surface of the tool. Unfortunately, however, the abrasive action of the slurry, during such an operation, causes a detrimental wearing away of the preformed surface of the tool which, after continued use, eventually introduces errors of curvature to said tool surface and, consequently, to the surfaces of the lens blanks generated thereby. For this reason, it has been necessary to carefully gauge the curvature of the abrading surface of the tool before each fining operation and, when an excessive amount of wear has taken place, the abrading surface is renewed by a commonly known time-consuming and costly conventional tool truing operation. It has been found that the average tool must be trued after each 3 or 4 grinding operations and eventually this requires replacement of the tool.

Another disadvantage of such tools in the past, in order to aid in avoiding the forming of so-called "burned" spots on the generated surface, has been the necessity, when truing a tool surface, to groove or recess portions of said surface in an attempt to produce a more even distribution of the abrasive slurry during the abrading operation. Such grooving or recessing is also time consuming and costly.

The present invention, therefore, is intended to overcome the above-mentioned difficulties and other limitations inherent in present-day lens surfacing techniques through the provision of novel means and method for surfacing lenses or the like wherein the abrading surface of a tool of the above-mentioned type is provided with a readily replaceable facing which, when applied to said tool, will accurately assume the preformed shape of and become the effective abrading face of the tool.

Another object of the invention is to provide inexpensive detachable and disposable grinding face portions for a lens surfacing tool of the character described which may be simply and rapidly attached to or removed from the tool and which will protect and preserve the preformed surface thereof during the abrading operations and there-

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by eliminate the heretofore age-old expensive and time-consuming tool truing operations.

Another object is to provide an inexpensive disposable tool facing of foraminous material which may be quickly and simply shaped and attached to a preformed curved surface of a conventional lens grinding tool.

Another object is to provide a protective disposable wire mesh facing for a lens grinding tool of the above character which, because of the interwoven construction of the mesh, will be substantially self conforming to the surface shape of the tool when applied thereto and will more uniformly distribute the abrasive medium during the abrading operation.

Another object is to provide novel means and method of attaching a relatively thin facing of the above character to a lens grinding tool.

A further object is to provide novel means and method of eliminating the requirement of human judgment in gauging lens grinding tools and the necessity of having an expensive surface truing machine as has heretofore been essential and to thereby permit a precision factory control of the curvatures of the grinding tools used in said grinding operations.

A still further object is to provide removable grinding facings for lens grinding tools of the above character which facings are of approximately the same thickness as that of the conventional polishing pads normally subsequently applied to the curved surfaces of said tools for polishing purposes, whereupon replacement of a grinding facing with a conventional polishing pad will produce substantially no change in the desired radius of curvature of the working face of the tool.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a top plan view of a lens surfacing tool embodying the invention;

Fig. 2 is a side elevational view of the tool shown in Fig. 1;

Fig. 3 is a fragmentary sectional view of one type of a grinding facing embodying the invention;

Fig. 4 is a fragmentary sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a fragmentary sectional view similar to Fig. 4 illustrating an alternative type of facing and attachment means embodying the invention;

Fig. 6 is a side elevational view of a further modified form of grinding tool embodying the invention; and

Fig. 7 is a diagrammatic fragmentary side view of a lens surfacing apparatus illustrating a particular use for a grinding tool of the type embodying the invention.

Referring more particularly to the drawings in which like reference characters represent like parts throughout the several views thereof, the device embodying the invention comprises a lens surfacing tool 10 having a body portion 11 formed of cast iron or any other suitable shape-retaining material having a curved surface 12 on one side thereof shaped substantially to the curvature desired to be formed on one side of a lens blank and a wire mesh facing 13 detachably secured thereto.

In such an arrangement, the exposed surface of the facing 13 becomes the abrading surface of the composite surfacing tool 10. This, of course, differs from the conventional surfacing tool in that it has been the practice heretofore to perform the lens abrading operations directly upon the curved preformed surface 12 of the tool which unavoidably causes a wearing away of said surface and, after continued use, introduces errors of curvature and other deformities in the resultant finished surfaces of the lens blanks being abraded thereby.

It is particularly pointed out that although the immediate description is directed principally to a wire mesh

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type of facing, it is conceivable that other readily conformable types of foraminous facing materials may be used while being well within the scope of the present invention.

In an attempt to avoid the well-known time-consuming and costly surface truing operations common to the trade, sheet-like replaceable coverings or facings of metallic foil or the like have been used to protect the abrading surface of the tools. In practice, however, the use of such coverings has met with little or no success since it has been found that they are not readily conformable to the various degrees of curvature required in the trade, particularly when constructed of a thickness and/or durability sufficient to withstand at least one abrading operation. In this case, the problem of conformability has, of course, led to the production of inferior lens surfaces caused primarily by folds, creases or stretched areas in the foil covering, which unavoidably occur while attempting to fit the foil to the abrading tool.

With this in mind, it is pointed out that the wire mesh facing 13 of the present invention may be of any desired thickness or durability since the interwoven condition of the strands 14 thereof is such as to permit said strands 14 to shift laterally relative to each other in such a manner as to allow the overall facing 13 to precisely assume the shape of the surface 12 to which it is applied.

A soft steel galvanized wire mesh of 30 x 30 strands per inch with a wire size of approximately .007 inch has proven, for all practical purposes, to produce the most satisfactory results both from a standpoint of durability and conformability. However, other combinations of wire sizes, mesh structures or types of wire such as bronze, nickel, etc. may be used.

Since the wear, normally incurred upon the abrading surface of the conventional cast iron surfacing tool, will, in the case of the present invention, take place upon the abrading surface of the wire mesh facing 13, it is essential that said facing be of a readily replaceable and disposable type which may be simply, efficiently and quickly attached to or removed from the surface 12 of tool 10. In this respect, the above-mentioned steel galvanized mesh has proven to be of a durability sufficient to out live the wearing effect of at least one lens surfacing operation while accurately producing the resultant surface of a lens blank being abraded thereon. Although a single wire mesh may be repetitively used without introducing any great distortion to the resultant lens surfaces being formed, it has been found that in order to maintain a high standard of precision in said resultant lens surfaces, it is most practical to replace the mesh facing after each surfacing operation.

With regard to the matter of attaching the facing 13 to the surface 12 of tool 10, it is pointed out that this may be accomplished in many ways other than those shown or described herein. Nevertheless, the present invention is directed principally to a few novel and highly effective types of attachment means. Figs. 3 and 4 best illustrate one preferred form in which the wire mesh 13, being initially in sheet-like form is sprayed or otherwise provided on one side thereof with a suitable, relatively thin layer of any one of many commercially available slow setting water proof adhesives, and immediately thereafter flocked with a synthetic or natural fibrous material 15 such as, for example rayon, cotton or the like. The fibrous material is preferably selected to be in lengths of $\frac{1}{16}$ of an inch or shorter. The flocking of the mesh may be accomplished by blowing or otherwise applying the fibrous material 15 to the above-mentioned adhesive treated mesh before the said adhesive has set and simultaneously electrostatically, or otherwise causing the major portion of each of the fibers of the flocking to stand away from the adhesive. Upon subsequent setting, the adhesive then bonds a part of each of the fibers of the flocking 15 securely to the wire mesh and provides an overall plush coating which may be readily attached to the surface 12 of a tool 10 by spraying or otherwise applying a second

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adhesive coating 16 to either the surface 12 or the flocking 15 and pressing the wire mesh against the surface 12. In pressing the wire mesh 13 against surface 12, said mesh 13 will automatically accurately assume the preformed shape of said surface 12 due to the relatively loose woven construction thereof, as described above. It is pointed out that this method of attachment allows the flocked wire mesh, when in large sheet-like form, to be cut to the approximate contour shape of the surface of the tool, Figs. 1 and 2, prior to being attached thereto. By so doing, a saving in the wire material is accomplished since no overlapping of the sides of the body portion 11 of the tool is necessary.

Another method of attaching the wire mesh 13 to tool 10 is shown in Fig. 5 wherein one side of the mesh 13 is suitably coated with a heat sensitive type of adhesive 17 such as for example, a composition of 75% rosin and 25% hydrogenated methyl ester of rosin or other adhesive having similar characteristics, which is adapted to fill in and around the woven strands 14 of the mesh 13 and provide an all-over coating which is securely bonded to the mesh and which would then be directly applied to the surface 12 of tool 10 by heating the tool 10 an amount sufficient to cause said adhesive to soften and form a bond between the surface 12 and mesh 13. Alternatively, any known pressure-sensitive type of adhesive may be used in place of adhesive 17. In either case, the mesh 13 having the adhesive material 17 thereon enables the mesh to be cut to size and stocked for future use. The use of a pressure-sensitive adhesive eliminates the necessity of having to clean the surfaces 12 of tools 10 after each removal of the wire mesh 13 since said adhesive normally tends to be more positively bonded to the interwoven strands 14 of the mesh and separates more cleanly from the smoother surface 12 of the tool. The above-mentioned adhesives, of course, in the cases of both Figs. 4 and 5 are of a type which will securely retain the mesh 13 in operative position of use while permitting said mesh to be easily and simply stripped from the tool following the lens surfacing operations. The surfaces 12 may however, be cleaned with a suitable adhesive solvent prior to each application of a new wire mesh facing if desired.

A further alternative in applying the wire mesh 13 to tool 10 is to simply cut the mesh 13 large enough to overlap the sides of the body portion 11 of tool 10, as shown in Fig. 6 and to securely attach said mesh to the tool 10 by means of a spring-type clamp 18 or any other suitable clamping means. This method obviously requires the use of a larger piece of mesh 13 than the above-mentioned methods but, on the other hand, does not require the use of adhesives.

It is particularly pointed out that although the curved surfaces 12 of the surfacing tools 10 are illustrated as being convex, the wire mesh facings 13 may be made to conform to and be applied to concave tool surfaces.

Referring more particularly to Fig. 7 the tool 10 is generally secured to a tool-supporting arm 19 or the like of a lens surfacing machine by a clamp 19a, such as diagrammatically illustrated, and a lens blank 20 having been previously properly adhesively attached to a holder 20a, is positioned upon the wire mesh facing 13 of the tool 10. An oscillating motion is then usually imparted to the arm 19 while the attached lens blank 20, through suitable alignment retaining means 21 and crank spindle 22, simultaneously describes a path of movement relative to that of the tool 10. The combined movements between the lens blank 20 and mesh 13 then produces a scrubbing action on the surface of the blank and an abrasive slurry 23 embodying particles of selected size is applied to the mesh 13 so as to lie between said mesh and blank and due to the scrubbing action, abrade said surface of the blank to a point where it will assume precisely the shape of the abrading face

of the wire mesh 13. It is pointed out that the wear due to the abrasive action takes place at the outer face of the wire strands 14.

An important feature of the present invention is that the interwoven condition of the wire mesh 13 permits the abrasive slurry 23 to flow in between and around the strands 14 of said mesh 13 in such a manner as to more evenly distribute said slurry to all parts of the surface of the lens blank being abraded. This, of course, eliminates the so-called undesired "burned spots" on the lens blanks which occasionally occur when a conventional smooth surface cast iron tool is used. "Burned spots" are caused by an improper distribution of the abrasive particles between the engaging surfaces of the lens blank and tool and the resultant breaking down of said particles which effectively causes the lens surface being abraded to be in direct contact with the tool surface.

To more fully understand another important feature of the present invention, namely that of providing factory-controlled surface curvatures on abrading tools of the above-character, it is pointed out that heretofore it has been the practice to repeatedly use the conventional cast iron smooth surface tool until the abrading surface thereof has been distorted by wear to a point where, in accordance with the judgment of an operator, the surface is so worn as to produce inferior lenses. Human errors of judgment in such cases are, of course, very common since many factors must be considered. For example, a greater amount of tool wear can be tolerated for the production of weak curves on lens blanks than in the case of the stronger curves. Sighting between a curve gauge and tool surface, being checked for wear, demands great skill and judgment on the part of the operator in determining the future usefulness of the tool.

By providing a factory-controlled surface curvature 12 on the body portion 11 of an abrading tool 10 of the type embodying this invention and providing disposable and replaceable wire mesh facings 13 of the above-described character to protect said factory-controlled surface 12, the above-mentioned errors of human judgment are eliminated. In addition, and equally as important particularly from an economical standpoint, the costly and time-consuming commonly known tool surface truing operations can be completely abolished, since the surfaces 12 of the tool 10 are never subjected to wear or abrasion.

With the present invention, the surface 12 of tool 10 would be provided at the factory with curvatures of radii so controlled as to compensate for the thickness of the wire mesh facing 13 to be subsequently applied thereto whereby the radii of curvatures at the abrading surface of the facing 13, when applied to the tool, would be precisely that of the resultant surface desired on the lens blank. The body portions 11 of the abrading tools 10 would then be either molded directly to the desired shapes through the use of sintered metals or plastics or tooled in the usual manner at the factory.

Subsequent to an abrading operation, it has been the practice heretofore to attach a polishing pad to the abrading surface of the conventional surfacing tool and to finish the previously abraded lens blank surface by a polishing operation which is conducted in a manner similar to that of the abrading operation with the exception of applying a polishing medium to the tool and lens blank rather than an abrasive slurry. In such cases, however, when the face of the tool was directly used in abrading and was provided with the true curve to be reproduced on the blank the thickness of the polishing pad in many instances caused a noticeable change in the resultant radius of curvature of the polished surface formed thereby and also errors of curvature, due to wear of the abrading surface of the tool, which were brought about by the previous abrading operations and were also introduced during said polishing operation.

The present invention avoids the above-mentioned difficulties and permits the use of more recently introduced superior types of plastic polishing pads throughout the various ranges of curvatures known to the trade since the wire mesh abrading facing 13 can be controlled to be of a thickness substantially equal to that of a polishing pad which would subsequently replace said facing 13 during a polishing operation. Moreover, no errors in curvature due to wear during a previous abrading operation can possibly exist since such wear would be incurred only upon the disposable wire mesh facing 13.

From the foregoing description, it is apparent that all the objects and advantages of the invention have been accomplished to provide novel means and method for surfacing lenses.

It will also be apparent that many changes may be made in the details of construction and arrangement of parts shown and described without departing from the spirit of the invention as expressed in the accompanying claims. Therefore, it is to be understood that all material set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having described my invention I claim:

1. A replaceable facing for a lens surfacing tool comprising a sheeting of interwoven metallic wire strands contoured to overlie and to intimately engage the effective surface of said lens surfacing tool and means for retaining said sheeting of interwoven metallic wire strands on said lens surfacing tool.

2. A protective abrading facing for a lens surfacing tool comprising a foraminous sheeting contoured to overlie at least the abrading side surface of a lens surfacing tool to be used therewith, said sheeting embodying a plurality of closely related interwoven metallic wire strands, said strands being adapted to shift laterally with respect to each other whereby said sheeting will accurately assume the particular shape of said side surface of the tool when forced thereagainst and thus substantially reproduce said particular shape at its exposed surface, attachment means bonded to a side of said sheeting to permit said sheeting to be detachably secured to said abrading side surface of the tool when properly fitted in a position of use thereon.

3. An abrading facing for a lens surfacing tool embodying a sheeting of interwoven metallic wire strands, said sheeting being contoured to overlie at least the abrading side surface of a lens surfacing tool to be used therewith, the interwoven condition of said wire strands being such as to permit relative lateral movement thereof whereby said sheeting will readily conform to the particular shape of said abrading side surface of said tool when forced thereagainst and attachment means for detachably securing said sheeting to said lens surfacing tool embodying an adhesive-type bonding material between said sheeting and said abrading side surface of the tool.

4. An abrading facing for a lens surfacing tool embodying a sheeting of interwoven metallic wire strands, said sheeting being contoured to overlie at least the abrading side surface of a lens surfacing tool to be used therewith, the interwoven condition of said wire strands being such as to permit relative lateral movement thereof whereby said sheeting will readily conform to the particular shape of said abrading side surface of said tool when forced thereagainst and attachment means for detachably securing said sheeting to said lens surfacing tool, said attachment means embodying a flock material bonded to one side of said sheeting to form a plush-like surface thereon and an adhesive for bonding said plush-like surface to said abrading side surface of the tool.

5. A foraminous abrading facing for a lens surfacing tool embodying a sheeting of interwoven wire strands, said sheeting being contoured to cover the abrading side surface of a lens abrading tool and additionally overlap a part of the edge portions of said tool, the interwoven condition of said wire strands being such as to permit

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relative lateral movement thereof whereby said sheeting will readily conform to the particular shape of said abrading side surface of said tool when forced thereagainst and attachment means for detachably securing said sheeting to said lens surfacing tool embodying a removable clamp member adapted to be placed in gripping surrounding relation with the edge portions of said sheeting when said sheeting is in position of use on said tool.

6. A lens surfacing tool comprising a body portion having one side shaped to fit within a supporting part of a surfacing machine with which said tool is to be used and its opposed side provided with a surface curvature substantially in conformity with the curvature desired of a surface of a lens to be formed by said tool and a foraminous facing overlying and detachably secured to said opposed side of the tool in intimate fitted relation with the surface curvature thereof.

7. A lens surfacing tool comprising a body portion having one side shaped to fit within a supporting part of a surfacing machine with which said tool is to be used and its opposed side provided with a surface curvature substantially in conformity with the curvature desired of a surface of a lens to be formed by said tool, a wire mesh facing overlying and detachably secured to said opposed side of the tool in intimate fitted relation with the surface curvature thereof, said facing embodying a plurality of interwoven wire strands adapted to shift laterally with respect to each other to cause the overall facing to conform to the surface curvature of said opposed side of the tool when forced thereagainst whereby said facing when in position of use on said surfacing tool will provide an exposed abrading surface thereon in conformity with the curvature of the surface of the tool to which it is applied and the texture of said exposed abrading surface resulting from the interwoven condition of said wire strands being such as to permit a uniform distribution of an abrasive medium between said abrading surface and a lens blank in engagement therewith during the surfacing operation.

8. The method of making a lens surfacing tool com-

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prising providing a rigid supporting member having one side shaped substantially to the curvature desired to be formed upon a lens blank, fitting a wire mesh facing in intimate engaging relation with said shaped side of the supporting member and detachably securing said facing in said fitted relation on said supporting member.

9. The method of making a lens surfacing tool comprising providing a rigid supporting member having a side thereof shaped substantially to the curvature desired to be formed upon a lens blank, providing an interwoven facing or stranded wire parts contoured to overlie at least said shaped side of the supporting member, forcing said facing into intimate engaging relation with said shaped side of the supporting member and thereby causing said stranded wire parts of said facing to shift laterally relative to each other an amount sufficient to cause the overall facing to conform to the shape of said side of the supporting member and detachably securing said facing in fitted relation on said supporting member.

10. A replaceable facing for a lens abrading tool having a surface curvature of a controlled shape thereon, said facing consisting of a thin sheeting of strands of relatively rigid wirelike material of controlled cross-sectional size loosely interwoven so as to have interstices between the strands and throughout the area of said sheeting, said sheeting, because of the loosely interwoven strands which are readily shiftable relative to each other, being adjustable to relatively intimately fit the surface curvature of the tool while retaining the interstices for permitting the flow and pocketing of the abrasive slurry normally applied to such tools during the use thereof, and means for replaceably securing said sheeting to said tool.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 17,576	Maynard	Jan. 28, 1930
369,431	Brown	Sept. 6, 1887
1,166,639	Hill	Jan. 4, 1916
2,024,303	Obrig	Dec. 17, 1935
2,544,950	Ritterbusch et al.	Mar. 13, 1951