Aug. 19, 1952 R. LANIUS 2,607,174

METHOD OF GRINDING EYEGLASS LENSES

Original Filed Aug. 23, 1946 3 Sheets-Sheet 1

Fig. 1.

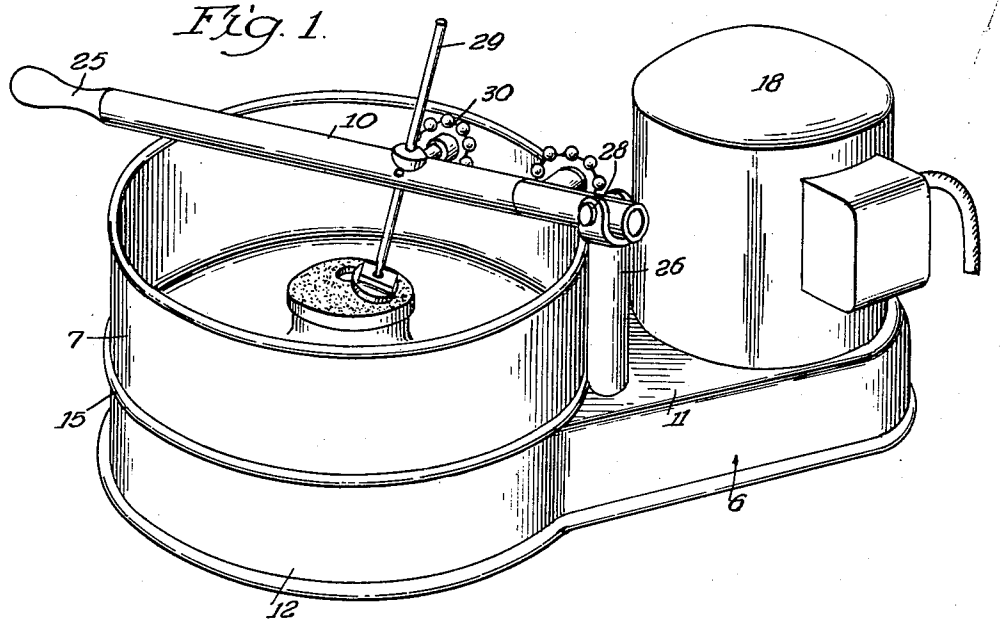
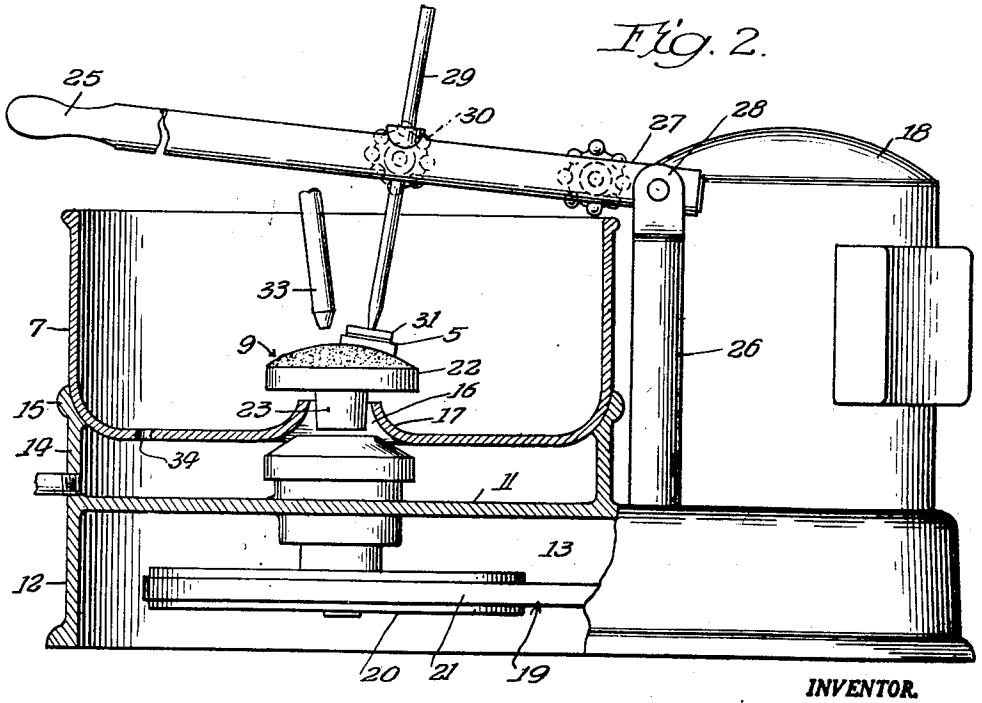


Fig. 2.



INVENTOR.
Ralph Lanius
By Fred Gerlach
atty.

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Fig. 3

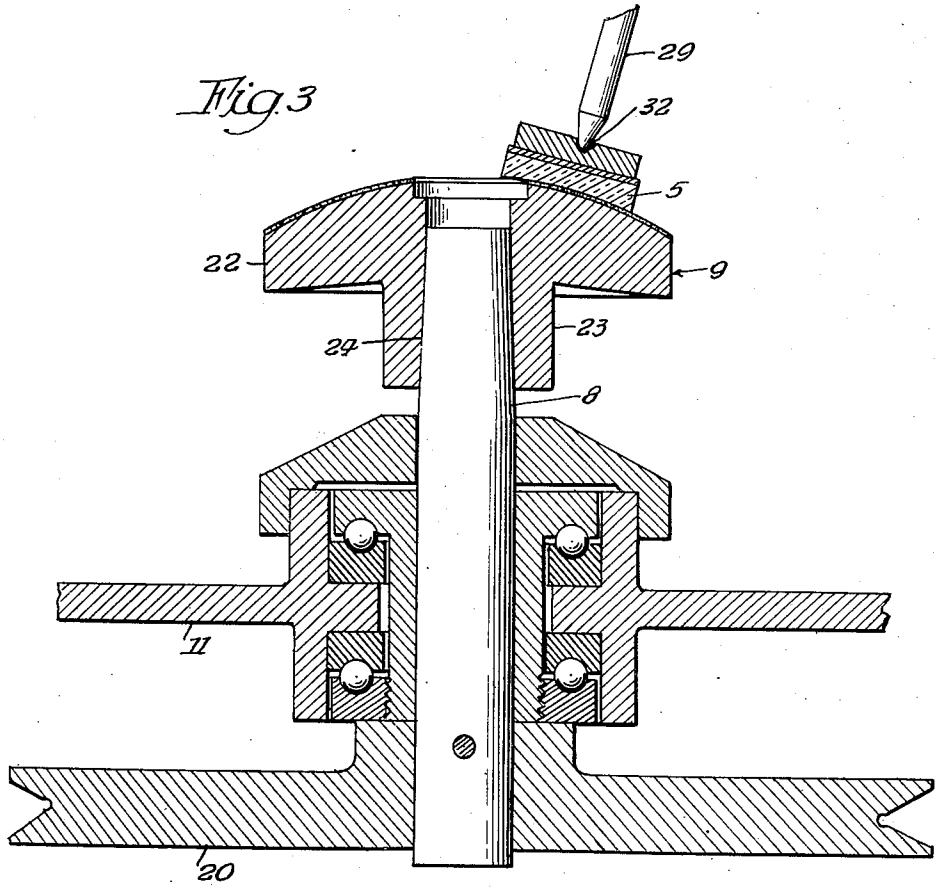
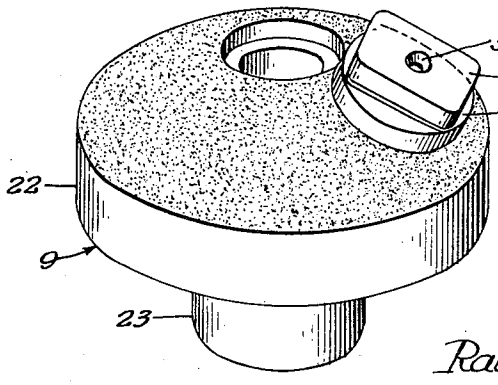


Fig. 4



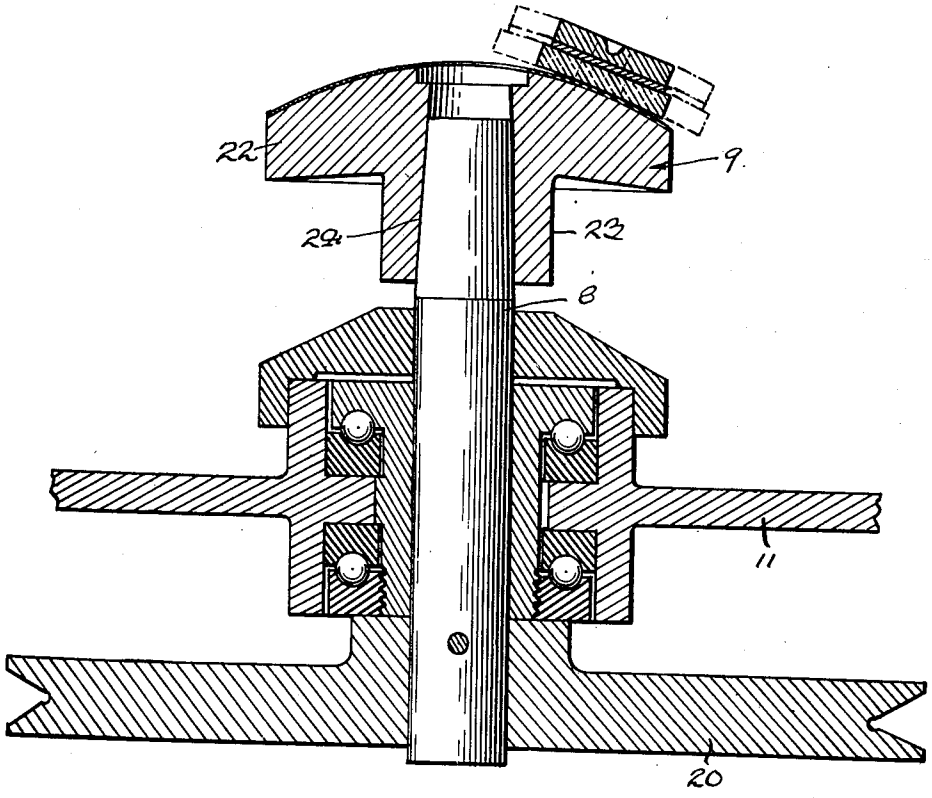
INVENTOR.
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By Fred Gerlach
Atty

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Fig. 5



Inventor:
Ralph Lanius
By: Fred Gerlach
Atty.

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UNITED STATES PATENT OFFICE

2,607,174

METHOD OF GRINDING EYEGLASS LENSES

Ralph Lanius, Cincinnati. Ohio, assignor to Super-Cut, Inc., Chicago, Ill., a corporation of Illinois

Continuation of application Serial No. 692,635, August 23, 1946. This application November 25, 1949, Serial No. 129,350

1 Claim. (Cl. 51—284)

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The present invention pertains to the art of grinding lenses for eyeglasses.

In grinding eyeglass lenses to a predetermined curvature it has heretofore been customary to employ or utilize a grinding apparatus comprising a vertically extending power driven spindle and a bowl-shaped receptacle having in the bottom thereof a central aperture through which the upper portion of the spindle extends, together with a cast iron grinding tool which is mounted on the upper end of the spindle so as to rotate with the spindle and has the top surface thereof provided with such a diopter curve that its contour is in conformity with the desired curvature for the lens. The receptacle surrounds the tool and serves to retain beneath the tool a batch of abrasive material in the form of a mixture of water and loose abrasive particles such as silicon carbide particles or aluminum oxide grains. In connection with a lens grinding operation the lens blank is applied to one side of a cast metal holder by way of pitch or like material. Thereafter the blank is positioned so that the exposed surface thereof rests on the upper surface of the cast metal grinding tool and downward pressure is exerted on the blank by way of a substantially horizontal lever which has one end thereof mounted for limited universal pivotal movement and its other end shaped to form a handle and carries on the central portion thereof a depending rod, the lower end of which is pointed and is adapted so to fit within a socket on the upper side of the cast metal holder as to permit the holder and lens to spin or revolve relatively to the tool during a grinding operation. After proper positioning of the blank and during drive of the tool by the spindle the operator scoops the abrasive material from the bottom of the receptacle and deposits it onto the upper surface of the tool so that the tool together with the material effects the desired grinding of the bottom surface of the lens blank. Ordinarily the blank is subjected to four successive grinding operations. First of all the blank is rough ground by using in the grinding apparatus abrasive material, the abrasive particles of which have a mesh size between 45 and 80. After the rough grinding operation the blank is ground in a similar machine having the same type of grinding tool and abrasive material, the abrasive particles of which have a mesh

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size between 120 and 150. The second grinding operation serves to reduce roughness in the form of deep scratches, grooves and pits. After the second grinding operation the blank is ground in a third apparatus having the same type of a grinding tool and a batch of abrasive material, the abrasive particles of which have a mesh size between 220 and 280. The purpose of the third grinding operation is further to reduce roughness on the ground surface of the blank. At the conclusion of the third grinding operation the blank is subjected to a so-called "finish" grind by grinding it in a fourth apparatus having the same type of grinding tool and a batch of abrasive material, the abrasive or grit particles of which have a mesh size between 1000 and 1250. At the conclusion of the "finish" grinding operation which serves completely to eliminate roughness the ground surface of the blank is polished by placing it against a power driven felt pad that is treated or coated with rouge, cerium oxide or like material. In some instances at the conclusion of the aforementioned operations the other side of the blank is ground and polished in a similar manner in order to provide the desired curvature. The aforementioned method of grinding eyeglass lenses is subject to many objections. In the first place, grinding of the lens blank is extremely slow by reason of the fact that the grinding tools must by necessity be driven at a slow speed, such, for example, as 400 R. P. M. in order to prevent the loose abrasive material which is applied to them from being flung out of place by centrifugal force. Secondly, only a highly skilled operator is capable of carrying out the method because the operator must manipulate the lens blank with one hand and feed the loose abrasive material with the other hand. Thirdly, the cast iron grinding tools which are employed in the rough grinding operation and the subsequent grinding operations rapidly wear down and lose their proper curvature due to the action of the abrasive material, and hence require frequent and costly reshaping or dressing. Fourthly, the blank is likely, especially in connection with rough grinding thereof, to crack or have its edges chipped because of the vibration which is set up due to the large sized loose abrasive or grit particles rolling between the blank and the curved upper surface of the grinding tool. Fifthly, the various grinding

operations, due to the fact that loose or paste variety abrasive material is employed, are essentially untidy and laborious and often result in the operator's hands being cut or injured. Sixthly, the cost incident to grinding the lens is high because the loose abrasive material must be frequently washed and cleaned and replaced or renewed due to becoming dull by reason of the accumulation of glass particles in it. Seventhly, the method or technique does not readily lend itself to so-called "cylinder" grinding, i. e., grinding the blank by holding it and the holder against spinning while at the same time rocking them back and forth radially with respect to the tool, because the operator can use but one hand to manipulate the blank and holder in view of the fact that the other hand is required to feed the loose abrasive material onto the upper surface of the tool for grinding purposes.

The primary object of this particular invention is to provide a method of grinding eyeglass lenses which eliminates the objections or defects of the method heretofore employed and is characterized by the fact that it may be carried out much more expeditiously and with greater facility and at materially less cost and without cracking or chipping the blanks. In general the improved method comprehends utilizing in the initial or so-called rough grinding operation a grinding tool with its upper or working curved surface in the form of diamond particles of a particular mesh size in a matrix, and rotating the tool at a speed of no less than 1250 R. P. M. By utilizing such a grinding tool the time incident to grinding the lens blank is materially reduced, and it is possible to eliminate the first and second intermediate grinding operations. In addition, the tool holds its shape more or less indefinitely and hence will grind a great number of lens blanks to the desired curvature without the necessity of being dressed or refinished. Another advantage in using a grinding tool, the upper or operative curved surface of which is in the form of diamond particles in a matrix, resides in the fact that it is possible to drive the tool at a comparatively high speed and there is no loose abrasive material which must be handled by the operator. Still another advantage resides in the fact that since no loose abrasive material is necessary vibration of the blank being ground is eliminated and hence there is substantially no likelihood of the blank becoming cracked or chipped. A further advantage resides in the fact that in connection with cylinder grinding of a lens blank the operator, because no handling of loose abrasive material is necessary, may use both hands and hence obtain more accurate grinding of the blank.

A further object of the invention is to provide an eyeglass lens grinding method which is an important improvement in the art and efficiently and effectively accomplishes its intended purpose while at the same time producing inherently new results.

Other objects of the invention and the various advantages and characteristics of the present eyeglass lens grinding method will be apparent from a consideration of the following detailed description.

The invention consists in the method which is hereinafter more particularly set forth and defined by the claim at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a perspective of an apparatus for use in carrying out the improved method of eyeglass lens grinding;

Figure 2 is a vertical longitudinal section of the apparatus;

Figure 3 is an enlarged vertical section of the spindle and grinding tool of the apparatus, showing a lens blank being spherically ground by permitting it to spin while moving it radially with respect to the tool;

Figure 4 is a perspective of the tool; and

Figure 5 is another enlarged vertical section of the spindle and grinding tool, illustrating a lens blank being provided with a cylindrical grind by holding it against rotation and rocking it back and forth bodily in a radial direction with respect to the tool.

The method constituting the invention involves grinding to a predetermined desired curvature an eyeglass lens blank **5** and is designed or adapted to be carried out in an apparatus like that which is shown in the drawings. In general such apparatus comprises a base structure **6**, a bowl-shaped receptacle **7**, a vertically extending spindle **8**, a lap type grinding tool **9**, and a pressure exerting lever **10**.

The base structure **6** is horizontally elongated and comprises a horizontal top wall **11** and a continuous depending side wall **12**. The top wall **11** defines with the side wall **12** an open bottom compartment **13** and has at one end thereof an integral upstanding annular flange **14**. The receptacle **7** rests on, and is shaped conformably to, a seat **15** on the upper margin of the flange **14** and has a circular aperture **16** in the central portion of its bottom wall. The portion of the bottom wall that defines the aperture **16** is shaped to form an upwardly extending tubular neck **17**. The spindle **8** has the central portion thereof journalled in anti-friction bearings on the top wall **11** of the base structure **6** and is arranged so that the lower end thereof projects into the compartment **13** and its upper end projects upwards through the neck **17**. Drive of the spindle is effected by way of an electric motor **18** and a belt and pulley connection **19**. The motor **18** is mounted on the end of the top wall **11** that is opposite the upstanding flange **14** and is arranged so that the armature shaft thereof extends vertically. The belt and pulley connection **19** is located in the compartment **13** and includes a pulley (not shown) on the lower end of the armature shaft of the motor **18**, a pulley **20** on the lower end of the spindle, and a belt **21** around the two pulleys. Preferably the electric motor **18** is a constant speed motor and serves in connection with the belt and pulley connection **19** to drive the spindle **8** at a speed no less than 1250 R. P. M. In practice it has been found that so far as the improved method is concerned the desired results are obtained when the spindle is driven at a speed between 1250 and 6000 R. P. M. If the spindle is driven at a speed less than 1250 R. P. M. the time incident to carrying out a lens blank grinding operation is too slow for economical purposes. The upper end of the spindle **8** is tapered to a small extent as shown in Figure 3.

The grinding tool **9** constitutes the medium for grinding the lens blank **5** to the desired curvature and is in the form of a wheel. It consists of a circular or disc-like body **22** and a hub **23**. The body and hub are preferably formed integrally with one another. Brass, bronze or any

other suitable metal is used to form the tool 9 and the latter is preferably in the form of a casting. The body 22 extends horizontally when the grinding tool is in its normal or operative position and has the upper surface thereof provided with such a diopter curve that its contour corresponds to, or is the complement of, the curvature that is desired to be formed in the lens blank in connection with spherical grinding thereof. If the lens blank is to be ground in a concave fashion the upper surface of the body 22 has a convex diopter curve, as shown in the drawings. If the lens blank is to be ground so as to have a convex surface the upper or working surface of the tool body 22 is made so that it has a concave diopter curve. The upper surface of the body 22 of the grinding tool is covered with diamond particles which are embedded in a matrix. The latter may be made of any suitable material and serves to bond the diamond particles rigidly or fixedly to the upper surface of the tool body 22. In practice it has been found that optimum results are obtained when the diamond particles are of mesh size from approximately 60 to 120. If the diamond particles are too coarse as the result of being lower than approximately 60 mesh they either so chip the blank as to render the blank useless or cut too deeply into the lens blank and make it necessary for the operator to perform an intermediate grinding operation on the blank with a different wheel of the same diopter curve but with finer diamonds. On the other hand, if the diamond particles are too fine as the result of the mesh size thereof being in excess of approximately 120 the time necessary to effect a lens blank grinding operation is prolonged to the point where the method or technique is impractical or has no advantage over the heretofore employed eyeglass lens blank grinding method which utilizes a cast iron lap as the grinding tool or instrumentality. As shown in Figure 4, the diamond particles extend throughout the entire area of the upper surface of the tool body and are uniformly distributed throughout the matrix. The hub 23 of the grinding tool 9 is connected to, and depends from, the central portion of the circular body 22. It embodies a central socket 24 which is shaped and adapted to receive the upper end of the spindle 8. As shown in Figure 3, the socket 24 is upwardly tapered in conformity with the upper end of the spindle in order that there is a press or drive fit between the tool and the spindle when the tool is in its operative position. When it is desired to replace the tool with another grinding tool having a differently contoured working surface the tool is removed merely by forcing it upwards out of engagement with the upper end of the spindle 8. As shown in Figure 4 of the drawings the upper end of the socket 24 is open at the center of the disc-like body 22 and the diamond particles are in the form of an annular band, the width of which is approximately equal to the size of the lens blank 5. The width of the aforementioned band is the distance between the inner and outer margins or edges of the band. As clearly illustrated, the band consisting of diamond particles and the latter's matrix is essentially solid or continuous.

The lever 10 of the grinding apparatus overlies the bowl-shaped receptacle 7 and normally extends substantially horizontally. One end of the lever is shaped to form a handle 25 and the other end of the lever is connected to the upper end of a standard 26 by a sleeve 27 and a bifurcated pivot element 28 in order that the lever is permitted to swing laterally and up and down and also rotate about its axis. A rod 29 extends through, and fits slidably in, a vertical hole in the central portion of the lever 10 and is releasably and adjustably secured in place by way of a knob equipped set screw 30. The lower end of the rod is pointed and is adapted in connection with a lens grinding operation to bear against a holder 31 for the lens blank 5. Such holder is in the form of a rectangular block of cast iron and has on the central portion of its upper surface a socket 32 for receiving the pointed lower end of the rod 29. The socket is so dimensioned or proportioned that when the pointed lower end of the rod is disposed in it during a so-called spherical lens grinding operation the holder together with the lens blank is free to spin relatively to the grinding tool 9.

In addition to the parts heretofore mentioned the grinding apparatus comprises a tube 33 for supplying a liquid coolant to the upper or working curved surface of the disc-like body of the grinding tool. One end of the tube is connected to any suitable source of coolant and the other end of the tube is positioned over the grinding tool body 22, as shown in Figure 2. A drain 34 is formed in the bottom wall of the bowl-shaped receptacle 7 in order to permit the coolant to drain from the receptacle after it has been discharged over the diamond particles constituting the working surface of the tool body.

Any coolant which is non-oily, non-slippery, non-toxic and non-rusting, does not necessitate cleaning of the lens blank after a grinding operation, will not permit filling of the spaces between the exposed portions of the diamond particles in the operating surface of the tool with ground glass particles, and is chemically stable may be used. Extremely desirable results have been obtained by using as the liquid coolant either of the materials which are now being marketed by Super-Cut, Inc., of Chicago, Illinois, under the trade names "Super-Cut Red" and "Super-Cut Green," or the material which is now being marketed under the name "Cimcool Optogrind" by Cincinnati Milling and Grinding Machines, Inc., of Cincinnati, Ohio. Water may also be utilized as the coolant, provided that it is treated with an agent for rendering it non-rusting.

When it is desired to grind the lens blank 5 the blank is mounted on the under side of the holder 31, pitch or other suitable material being employed to hold the blank in bonded or connected relation with the holder. After proper mounting of the lens blank 5 with respect to the holder 31 the blank is placed on the working or abrasive upper surface of the body 22 of the tool. Thereafter the pointed lower end of the rod 29 is located or positioned in the socket 32 in the upper side or face of the blank holder and the apparatus is set into operation by starting the electric motor 18. During drive of the tool at a speed no less than 1250 R. P. M. the operator moves the lever 10 back and forth in a sidewise direction in order to cause the blank to move substantially radially with respect to the tool body 22. During such movement the blank and holder spin and the band of diamond particles constituting the working upper surface of the tool body grinds the bottom surface of the blank. During the grinding operation the coolant is fed onto the working surface of the body of the tool by way of the tube 33, and downward pressure is applied to the blank by way of the lever 10. In connection with initial rough grinding of the

blank it is contemplated that the operator will exert on the end of the lever 10 a heavy downward pressure of approximately 5 to 15 pounds. After the lens blank has been rough ground to the predetermined or desired extent the downward pressure on the end of the lever is reduced to approximately one pound. When the blank is subjected to such light downward pressure for a limited period of time the diamond particles constituting the upper or working surface of the body of the grinding tool effect a smooth grinding of the blank and thus eliminate any deep scratches or furrows in the surface of the lens blank that is being ground. By reducing the downward pressure on the blank during the end of the rough grinding operation intermediate grinding operations are unnecessary. After the aforementioned rough grinding operation the ground surface of the blank has the diopter (spherical) curve of the tool through all meridians. Such surface is then provided with a "finish" grind and is subsequently polished in any conventional or well known manner. In practice it has been found that when the grinding tool is rotated at a speed of about 3500 R. P. M., the diamond particles have a mesh size of approximately 60 to 120 and are closely distributed throughout the matrix, as shown in Figure 4, and the downward pressure on the end of the lever 10 is approximately 15 pounds the blank is ground away at a rate of approximately 3 millimeters in 15 seconds. It has also been found that by materially reducing the pressure on the blank after rough grinding to the desired extent the ground surface of the blank is sufficiently smooth and free from deep grooves and scratches to permit it to be finish ground without intermediate grinding operations.

A large number of all eyeglass lenses that are ground require so-called cylindrical correction, which means that a lens must be provided with a predetermined curvature through one of its meridians and another predetermined, stronger or weaker, curvature through another meridian. In connection with the grinding operation, the operator by holding the lens blank stationary and applying downward pressure to one marginal part or another may either induce or eliminate any desired amount of prism. It is also contemplated that when it is desired to impart cylindrical correction to a lens after spherical grinding thereof, the operator will grasp the blank holder in such manner as to prevent it from spinning or rotating, and then rock the blank back and forth on the working surface of the rotating tool along one of the meridians of the blank for imparting the desired predetermined cylindrical curve thereto. The hereinbefore described method of imparting cylindrical correction to a lens is at least 5 to 6 times faster and far more accurate than the method heretofore used in the commercial production of an eyeglass lens, and since the operator is able more accurately to control the optical center of the lens being ground, the time required to finish such lens on a finish cylindrical machine is reduced by 50%, thereby effecting outstanding economical results. In connection with cylindrical grinding the blank is rocked radially with respect to the rotating tool, as shown in Figure 5 and it is first subjected to heavy downward pressure and then light pressure as in the case of spherical grinding. If the band of diamond particles on the grinding tool is convex as shown in Figures 4 and 5 cylindrical correction along one meridian after spherical grinding of the lens blank is, of course, effected by rocking the blank bodily back and forth in an arc, the radius of which is greater than the curvature radius of the upper surface of the grinding tool, it being obvious that if the blank is rocked back and forth in an arc, the radius of which is the same as the curvature radius of the upper surface of the tool, no cylindrical correction of the blank could be obtained and the blank would have only the spherical grind which it had originally.

The herein described method of grinding an eyeglass lens blank by way of a grinding tool, the working surface of which is formed for the most part of diamond particles may be carried out in an extremely short length of time and by a semi-skilled operator. It eliminates the necessity of subjecting the blank to intermediate grinding operations after the initial or original grinding operation, and eliminates cracking or chipping of the blank. The latter is directly attributable to the fact that by grinding with fixed diamond particles on the grinding tool the blank is not subjected to vibration, such as is encountered when loose abrasive is employed in connection with a cast iron grinding tool. By utilizing as the grinding medium for a lens blank fixed diamond particles that are bonded or fixedly attached to the body of the tool, the tool holds its shape for a long period of time and will grind a large number of lens blanks without the necessity of dressing or refinishing it. The subject method lends itself to cylinder grinding because the operator may use both hands in radially rocking the blank by reason of the fact that it is not necessary to apply with one hand loose abrasive material to the grinding tool.

This application is a continuation of United States patent application Serial No. 692,635, filed by me on August 23, 1946 and now abandoned.

The invention is not to be understood as restricted to the precise details set forth since these may be modified within the scope of the appended claim without departing from the spirit and scope of the invention.

I claim:

That improvement in grinding a glass eyeglass lens blank so that it has on one surface thereof a predetermined diopter curve, which comprises rotating about its axis, and at a speed of between 1250 and 6000 R. P. M. a comparatively wide, lap type, disc-like grinding tool having a small sized, concentric, circular grinding area contoured to possess said predetermined diopter curve and in the form of a fixed annular band which is substantially the same in width as the blank and consists of a metallic matrix together with diamond particles only having a mesh size from 60 to 120 and so closely distributed throughout the matrix that when the tool is driven at said speed and said one surface of the blank is first pressed against the grinding area under a comparatively heavy pressure of approximately 5 to 15 pounds and then under a materially less pressure of approximately 1 pound said grinding area operates initially to grind away said one surface of the blank at an extremely rapid rate and then conditions said one surface of the blank so that it is sufficiently smooth and free from deep grooves and scratches to permit it to be directly finish ground, delivering a liquid coolant onto the grinding area, during rotation of the grinding tool at said speed and while the coolant is being delivered grinding the blank by first manually pressing said one surface of the blank against the grinding area

under said comparatively heavy pressure and until said one surface has acquired the diopter curve of the tool and then manually pressing said one surface of the blank against the grinding area under said materially less pressure and for a sufficient length of time to condition it for finish grinding, and after so grinding said one surface of the blank finish grinding said one surface preparatory to polishing.

RALPH LANIUS.

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