March 26, 1935. L. L. GAGNON ET AL 1,995,676

LENS SURFACING MACHINE

Filed July 15, 1932 3 Sheets-Sheet 1

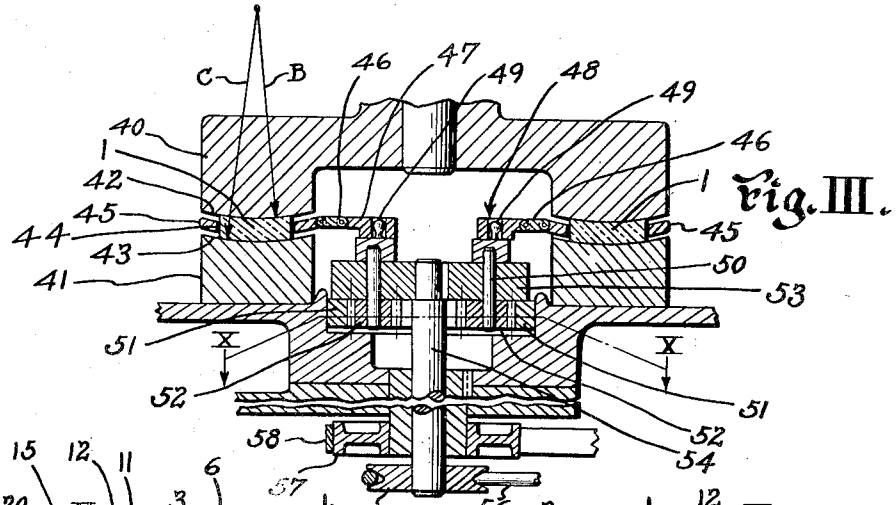


Fig. III.

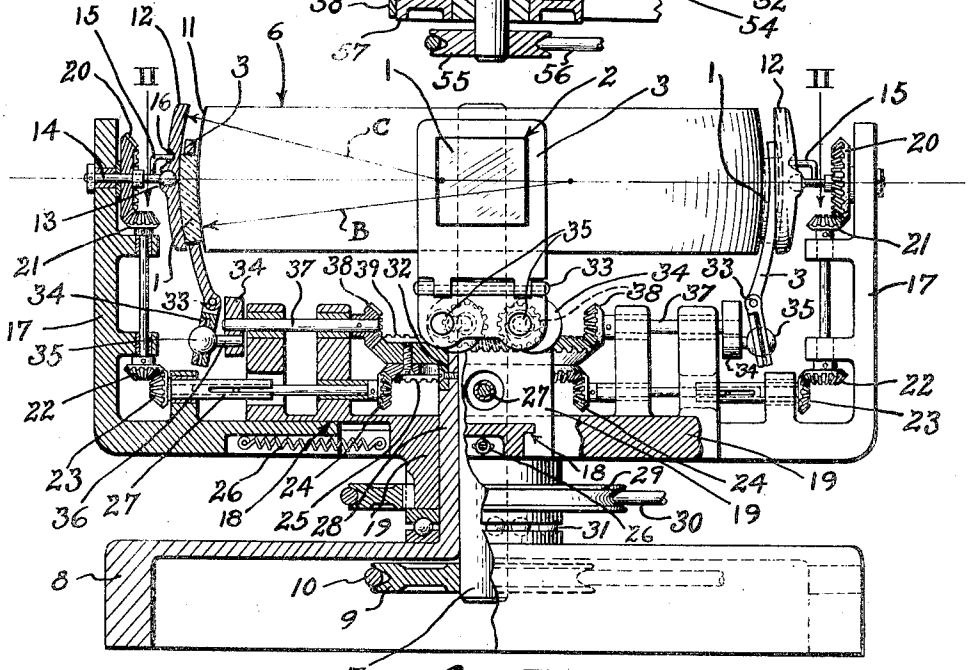


Fig. I

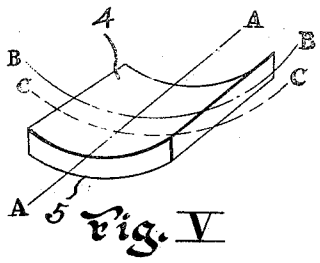


Fig. V

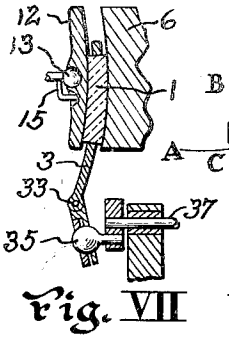


Fig. VII

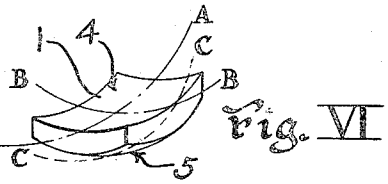


Fig. VI

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LENS SURFACING MACHINE

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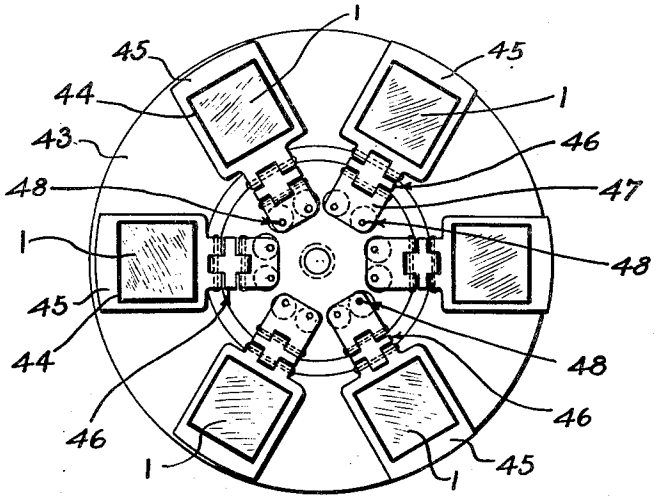



Fig. IV

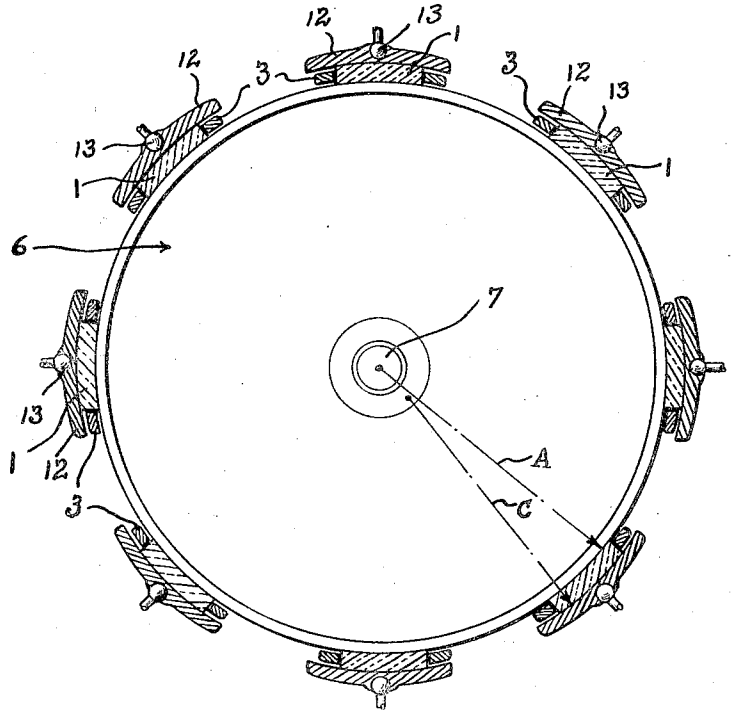



Fig. II

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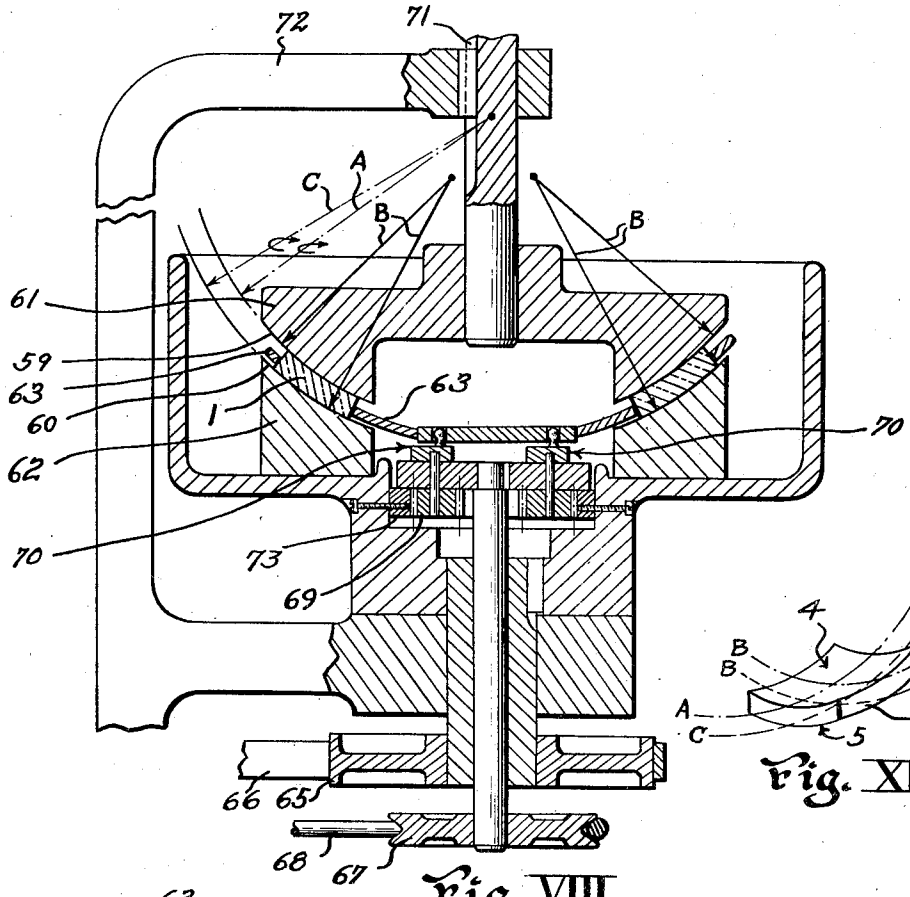



Fig. VIII.




Fig. XI.

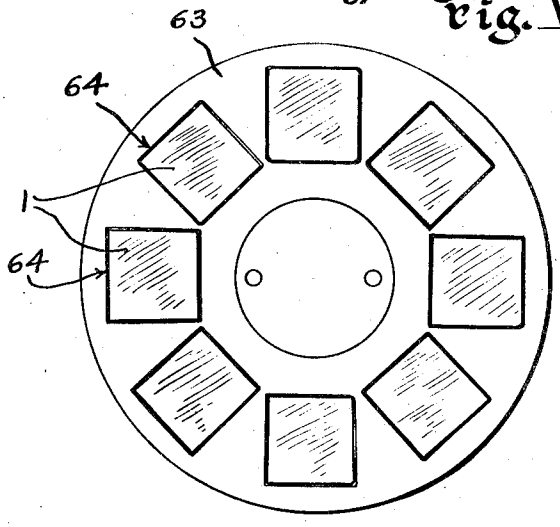



Fig. IX.

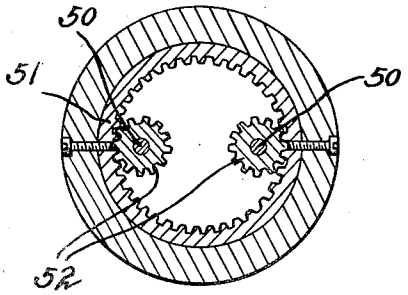



Fig. X.

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# UNITED STATES PATENT OFFICE

1,995,676

## LENS SURFACING MACHINE

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Application July 15, 1932, Serial No. 622,608

16 Claims. (Cl. 51—111)

This invention relates to improvements in abrading and has particular reference to improved means and processes of abrading the opposite surfaces of articles simultaneously.

One of the principal objects of the invention is to provide improved means and processes of abrading the opposite surfaces of articles simultaneously to varying surface curvatures.

Another object of the invention is to provide improved means and processes of abrading the opposite surfaces of an article simultaneously to curved surfaces and to forming one of said surfaces with curvatures of different radii in different meridians.

Another object of the invention is to provide improved means and processes of surfacing the opposite surfaces of cylindrical, spherical, bi-toric, toric etc., lenses simultaneously either with concentric or eccentric surfaces.

Another object is to provide improved means for rotating and gyrating the abrading and work holding means.

Another object is to provide improved means for imparting motion to the work holding means whereby the lines of abrasion are broken up, that is, are not repeated in one cycle after another.

Another object is to provide a work holder which will permit of surfacing the opposite surfaces of articles simultaneously to curved surfaces.

Another object is to provide improved means and processes of surfacing the opposite surfaces of a plurality of articles simultaneously to concentric or eccentric surfaces.

Other objects and advantages of the invention should become apparent from the following description taken in connection with the accompanying drawings, and it will be apparent that many changes may be made in the details of construction, arrangements of parts and steps of the processes shown and described without departing from the spirit of the invention as set forth in the accompanying claims. We, therefore do not wish to be limited to the exact disclosures made as the preferred forms only have been shown by way of illustration.

Referring to the drawings:

Fig. I is a side elevation partially in cross section showing one adaptation of the invention;

Fig. II is a fragmentary sectional plan view taken on line II—II of Fig. I;

Fig. III is a fragmentary side elevation of a modification;

Fig. IV is a plan view of the device shown in Fig. III, with the top lap removed and showing the work holding means;

Fig. V is a perspective view of one form of article made by the device shown in Fig. III;

Fig. VI is a perspective view of one form of article made by the device shown in Fig. I;

Fig. VII is a fragmentary sectional view of another modification;

Fig. VIII is a partial elevation in cross section showing a further modification;

Fig. IX is a plan view of the work holding means shown in Fig. VIII;

Fig. X is a cross section taken on line X—X of Fig. III; and

Fig. XI is a perspective view of one form of article made by the device shown in Fig. VIII.

In the past in forming articles having surface curvatures of different radii or having one or more of its surfaces formed with curvatures of different radii in different meridians, it has been believed that only one of said surfaces could be formed at one time. Articles having the above characteristics were, therefore, in most instances in the past attached to a separate holder with a single face exposed. This face was surfaced to the curvature desired and the article was then removed and attached to another holder and its opposite face was then surfaced to the curvature desired. This process required much time and labor in attaching the articles to the holders, it necessitated surfacing each article separately on each face and in general was expensive and impractical.

One of the prime objects, therefore, of the present invention is to provide improved means and processes whereby the opposite faces of a plurality of articles may be surfaced simultaneously and to any desired surface curvatures either spherical, plano, cylindrical, toric, bi-toric, etc., with the said surfaces in concentric or eccentric relation.

Referring more particularly to the drawings, wherein similar reference characters denote corresponding parts throughout the several views, the articles 1 to be abraded as shown in Figures I, III, VIII and IX are placed in the openings 2 in the work holders 3. The openings 2 and articles 1 are illustrated as being square in outline shape but it is to be understood that they may be of any shape desired, it only being necessary in instances when toric or cylindrical curves are formed that the said articles are prevented from rotating during the abrading operation. The work holders 3 may be convex as shown in Fig. I, concave as shown in Fig. VII or may be flat

or any shape desired depending upon the character of the surfaces which are to be placed upon the articles 1 that are to be abraded. As the apparatus depends somewhat upon the nature of the surfaces to be abraded, we will describe the construction and operation to produce each of the articles set forth in Figs. V, VI and XI.

The surfaces 4 and 5 of the article 1 shown in Fig. VI are the surfaces which are to be abraded in the apparatus shown in Fig. I. The articles 1 to be abraded are placed in the openings 2 of the work holding members 3. The surface 4 which in this instance is to be abraded to a toric curvature, that is, to a surface having different radii in different meridians is placed in contact with the abrading wheel 6. The abrading wheel 6 is carried by a shaft 7 rotatably mounted in the base 8 and is driven by a pulley 9 and belt 10. The abrading wheel 6 is provided with an abrading face 11, the curvature of which is controlled circumferentially of the wheel by the diameter of said wheel and transversely thereto by the curvature of the peripheral face of the wheel. As illustrated in Figs. I and II the curvature circumferentially of the wheel is controlled by the radius A and the curvature transversely of the wheel is controlled by the radius B. It is apparent that by changing the radii A and B, various different toric surfaces may be produced and by making the radii A and B equal, various different spherical surfaces may be produced.

If a cylindrical article or an article having a curve in only one meridian is desired the radius B is extended to infinity. This forms a flat transversely of the face 11 of the wheel and produces a curve in only one meridian of the article, which curve is controlled by the radius A.

Over the opposite surface 5 of each article 1 is placed a separate abrading tool 12 having a spherical surface thereon, the curvature of which is controlled by the radius C. Each abrading tool 12 is universally connected at 13 to a rotatable pin 14 and is rotated with said pin by an arm 15 which extends loosely into a slot 16 formed in the tool. The pin 14 is rotatably mounted in a slide arm 17 which is slidably mounted at 18 to a support 19, and is rotated in said arm by a train of gears 20, 21, 22, 23 and 24 connected with a main drive gear 25.

The slide arm 17 is urged longitudinally of the slideway 18 by a spring 26. This causes the abrading tool 12 to exert a constant pressure on the article 1 during the abrading operation. The gears 23 and 24 are connected by a telescoping shaft arrangement 27 to permit free movement of the slide arm 17 longitudinally of the slideway 18. The support 19 carrying the abrading tool 12, slide arm 17, and drive gears 21, 22, 23 and 24 is rotatably mounted on the central bearing support 28 of the base 8 and is driven by a pulley 29 and belt 30. A roller bearing 31 on the bearing support 28 permits free rotary movement of the support 19. The main drive gear 25 is mounted on the central support 28 and is rigidly attached thereto at 32. It is apparent that when the support 19, slide arm 17 and abrading tool 12 are rotated circumferentially of the abrading wheel 6 about the stationary gear 25 and bearing support 28 that the said gear 25 will rotate the gear 24 and transmit a rotary movement to the abrading tool 12. This causes the said tool 12 to abrade the surface 5 of the article 1.

The work holder 3 which is also connected with the rotatable support 19 is rotated circumferentially of the wheel 6 and remains in a definite relation with the abrading tool 12 and holds the surface 5 of the article 1 in constant abrading relation with said tool. This causes the surface 5 and the surface 4 which engages the surface 11 of the abrading wheel 6 to be simultaneously abraded. The work holder 3 is hinged at 33 to a plate 34 universally connected at 35 to a crank pin 36. The crank pin 36 is driven eccentrically of a shaft 37 by a gear 38 and main drive gear 39. The gear 39 is rigidly connected to the central bearing support 28 adjacent the gear 25. When the support 19 is rotated the main drive gear 39 causes the gear 38 to impart an eccentric crank movement to the work holder and causes the article 1 to move transversely between the abrading wheel 6 and tool 12. This causes the surface 4 which is a contra generic development of the wheel 6 to be formed on the article 1 and the surface 5 which is a contra generic development of the abrading face of the tool 12 to be simultaneously formed on the article 1. Attention is directed to the fact that a double crank arrangement is provided for each work holding member 3 so that a parallel motion is obtained during the abrading.

Fig. I illustrates the forming of a spherical surface on the convexed side of the article and Fig. II illustrates the forming of a spherical surface on the concaved side. It will also be understood that plus or minus lenses may be made by simply changing the radii of the curvatures of the abrading surfaces as is commonly known in the art. Attention is directed to the fact that although only one work holder and abrading tool 12 is described, several of said holders and abrading tools 12 are provided as shown in the drawings.

The operation is as follows: The articles 1 to be abraded are placed in their respective openings 2 between the abrading wheel 6 and abrading tools 12. Power is then applied to the pulleys 9 and 29 to rotate the abrading wheel 6 in a given direction about the axis of the shaft 7 and to rotate the articles 1 and abrading tools 12 in a direction opposite that of the abrading wheel 6. The rotary movement of the articles 1 and abrading tools 12 about the stationary main drive gears 25 and 39 causes the train of gears 24, 23, 22, 21 and 20 to impart a rotary movement to the abrading tools 12 about the axis of the pins 14, and also causes the gears 38 to impart a rotary eccentric movement to the crank pins 35. This causes a gyratory movement to be imparted to the work holders 3 and articles 1 in said holders; thus it will be seen that the work holders have a rotary and a gyratory movement, causing what is known as a break-up motion of the articles 1 between the tools. It will be understood that the speeds and directions of rotation of the tools and work holders relative to each other may be varied as desired. In this way it will be seen that both surfaces 4 and 5 of the articles 1 are abraded, it being understood that a suitable abrasive is supplied to the tools 6 and 12 during the said abrading. In removing the articles 1 from the work holders the slide arms 17 may be pulled outwardly and the finished articles removed and new articles placed therein. In Fig. VI the line A—A indicates the curve generated by the radius A, the line B—B the curve generated by the radius B and the line C—C the curve generated by the radius C. These various curves may be varied to produce the curvature and type of surface desired, the circumferential radius of the wheel 6 being changed by changing the diameter of the wheel.

The device of Figs. III and IV is adapted particularly for forming cylindrical articles of the type illustrated in Fig. V. It comprises broadly a pair of circular abrading tools 40 and 41 having concentric contra generic cylindrical abrading faces 42 and 43 thereon. The articles 1 to be abraded are placed in the openings 44 in the separate work holding members 45 between the abrading faces 42 and 43. The said work holders are hinged at 46 to crank plates 47 which are universally connected at 48 to the crank pins 49. The crank pins 49 are driven by the shafts 50 through the gears 52 and ring gear 51, see Fig. X.

The shafts 50 are rotatably mounted in a disc 53 which is connected to a shaft 54 driven by a pulley 55 and belt 56. The rotary movement, therefore, of the disc 53 causes the work holding members 45 and gears 52 to rotate about the axis of the shaft 54. The gears 52 are in constant mesh with the ring gear 51 and when revolved around said ring gear they rotate the crank pins 49 and impart a gyratory movement to the work holding members. The abrading tool 41, ring gear 51 etc., are rotated at a different speed than the work holding members 45 by a pulley 57 and belt 58. The upper abrading tool 40 is held against rotation during the abrading but is free to move toward and away from the abrading tool 42. This causes the said tool 40 to act as a weight to exert a continuous pressure on the articles 1 during the abrading.

The curves on the faces 42 and 43 of the abrading tools are concentric as illustrated by the radius lines B and C in Fig. III. The surfaces 4 and 5 formed by said curves are designated by the lines B—B and C—C in Fig. V. The line A—A designates the axis of the cylinder and also the shape of the surface formed on the article 1 in the meridian thereof which extends in the direction of its path of movement circumferentially of the abrading tools. It is apparent that by imparting motion of varying speeds to the abrading tool 41 and to the work holding members a rotary and gyratory movement will be obtained; the rotary movement of which will be in a direction circumferentially of and between the abrading tools 40 and 41 and the gyratory movement transversely of said tools. This produces a continuous break up motion and prevents the lines of abrasion from being repeated in one cycle after another.

It is to be understood that by changing the curve ratio of the abrading faces 42 and 43 of the abrading tools, several different surface shapes may be formed on the articles 1.

Fig. XI shows an article as formed by the device illustrated in Fig. VIII. This device is substantially identical with that of Figs. III and IV described above except for the tilting of the surfaces 59 and 60 of the abrading tools. This causes the curve of the circumferential edges of the tools to produce concentric curves in only one meridian of the articles 1. The radii of said curves being indicated by A and C in Fig. VIII. The curves B—B in the opposite transverse meridian are controlled by the radii B. The curves of the surfaces A—A and C—C in the meridian of the articles extending in the direction of the circumferential path of movement is controlled by the diameter of the abrading tools 61 and 62 and the curves B—B are controlled by the radii B of the transverse curved surfaces 59 and 60 of the abrading tools. By varying these curves and diameters of the tools many different shapes of surfaces may be produced.

The articles 1 in this particular instance are placed in an annular disc 63 having a plurality of openings 64 therein. The openings are illustrated as being substantially square with square shaped articles therein but it is to be understood that they may be of any shape desired providing means is provided to prevent rotation of the articles during the abrading, particularly in instances when articles other than spherical are being abraded.

The driving mechanism is substantially the same as that shown in Fig. III. It comprises the drive wheel 65 and belt 66 for rotating the abrading tool 62 and ring gear 73 at a given speed. The drive wheel 67 and belt 68 are adapted to rotate the disc 63 and gears 69 at a different speed. This causes the gears 69 to rotate the crank members 70 and impart a gyratory movement to the work holder 63 as it is rotated. The abrading tool 61 is held against rotation and is slidably mounted at 71 in a support 72 so that it is free to move toward and away from the abrading tool 62. This causes the tool 61 to impart a continuous pressure on the work during the abrading.

Although the abrading tools 12 set forth in connection with Figures I and II are shown and described as being rotatable and as having a spherical abrading surface, it is to be understood that they can be provided with any desired surface and can be mounted so that they will not rotate during the abrading. This being true particularly when lenses such as bi-toric, cylinders, concentric cylinders etc., are being made. The surface on said tools may also be flat if desired.

From the foregoing description it will be seen that we have provided simple, efficient and economical means and processes for producing all of the objects and advantages of the invention particularly that of producing a plurality of articles simultaneously with varying curvatures on their opposite surfaces.

Having described our invention we claim:

1. In a device of the character described, a pair of spaced abrading tools having opposed curved surfaces, one of said surfaces having different curvatures in different meridians, a work holding member mounted between the curved surfaces and shaped to move therebetween so that the major portion of the work holding portion thereof will remain within the limits of the areas of said curved surfaces, and means for imparting an orbital movement to the work holding means.

2. In a device of the character described, a pair of spaced abrading tools having opposed curved surfaces, one of said surfaces having a curvature of a different radius than the other, means to rotate one of said abrading tools relative to the other and means between said abrading tools for holding the work so that the major portion thereof will remain within the limits of the areas of the curved surfaces during the abrading, said means being such that opposite surfaces of the work may be abraded simultaneously to curvatures of different radii.

3. In a device of the character described, opposed abrading tools having curved surfaces, one of said surfaces having different curvatures in its opposite major meridians, means for moving one of said surfaces relative to the other and means for holding the work to be abraded between the curved surfaces so that the major portion thereof will remain within the limits of the areas of said curved surfaces, said holding means and work being separately movable relative to said curved surfaces.

4. In a device of the character described, opposed abrading tools having contra generic curved surfaces, and a plurality of separately movable work holders between said surfaces, each of said holders being adapted to hold a piece of work so that it may be abraded on its opposite surfaces simultaneously.

5. In a device of the character described, opposed abrading tools having curved surfaces, and a plurality of separately movable work holders between the opposed abrading tools, each of said work holders being adapted to hold a piece of work so that it may be abraded on its opposite sides simultaneously and so that the said work will not rotate about its own axis during the abrading operation.

6. In a device of the character described, opposed abrading tools having curved surfaces, one of said surfaces having compound curvatures of different radii, a plurality of separately movable work holders between the curved surfaces, each of said work holders being adapted to hold a piece of work so that it may be abraded on its opposite sides simultaneously and so that it will not rotate about its own axis during the abrading and means for moving each work holder separately about a given path between the curved surfaces and for maintaining the work in a parallel relation with one of said abrading tools during said abrading.

7. In a device of the character described, opposed abrading tools having abrading surfaces thereon, one of said surfaces having a spherical curvature and the other compound curvatures of different radii and means for holding the work to be abraded between said surfaces so that the major portion thereof will remain within the limits of the areas of said surfaces, said means being such that both sides of the work may be abraded simultaneously.

8. In a device of the character described, opposed abrading tools having abrading surfaces thereon, one of said surfaces having a spherical curvature and the other compound curvatures of different radii, means for holding the work to be abraded between said surfaces so that the major portion thereof will remain within the limits of the areas of said surfaces and so that both sides of the work may be abraded simultaneously and means for moving the work holding means separately about a given path between the abrading tools.

9. In a device of the character described, opposed abrading tools having abrading surfaces thereon, each of said abrading surfaces having compound curvatures of different radii and means for holding the work to be abraded between said surfaces so that the major portion thereof will remain within the limits of the areas of said surfaces and so that both sides of said work may be abraded simultaneously.

10. In a device of the character described, opposed abrading tools having abrading surfaces thereon, each of said surfaces being plano in one major meridian and curved in the opposite major meridian and means for holding the work to be abraded between said surfaces so that the major portion thereof will remain within the limits of the areas of said surfaces and so that both sides of said work may be abraded simultaneously.

11. The method of making a curved article consisting in engaging the opposite faces of the article with curved abrading surfaces, one of said surfaces having compound curvatures of different radii, confining the article to prevent free movement thereof and relatively moving the confined article so that the major portion of said article will remain within the limits of the areas of the abrading surfaces and moving said surfaces positively to abrade both faces of the article simultaneously.

12. The method of abrading an article which consists in supporting the article and positively moving it while causing it to be abraded on its opposite faces simultaneously by abrading members having abrading zones, one of which has compound curvatures, the major portion of said article being supported within the limits of the areas of the abrading zones during the abrading thereof.

13. The method of abrading an article which consists in supporting the article and positively moving it while causing it to be abraded on its opposite faces simultaneously by abrading members having opposed abrading zones of compound curvatures, the major portion of said article being supported within the limits of the areas of the abrading zones during the abrading thereof.

14. The method of abrading a plurality of articles to curved surfaces which consists in supporting the articles and positively moving them in a predetermined irregular path relative to the abrading means while causing them to be abraded on their opposite faces simultaneously to curvatures of eccentric radii.

15. A surfacing machine having, in combination, a concaved surfacing tool and a convexed surfacing tool mounted in spaced relation, means for supporting work against free movement between the surfacing tools with the opposite faces thereof engaged with the tools and so that the said work cannot be rotated bodily about its own axis with respect to said supporting means and mechanism for relatively moving said supporting means and the tools to transfer the work over the surfaces of the tools with an irregular motion to create an abrading action and so that the major portion of the work will remain within the limits of the areas of said surfaces.

16. The method of making a curved article consisting in engaging the opposite faces of the article with curved abrading surfaces, confining the article against free movement between the abrading surfaces and to prevent the said article from rotating bodily about its axis relative to said confining means and relatively moving the confined article and said abrading surfaces positively to abrade both faces thereof simultaneously to shape the engaged faces of said article to the curves of the abrading surfaces.

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