Dec. 24, 1940. E. VAN DER PYL 2,226,506

LAP

Filed Oct. 2, 1940

FIG. 2

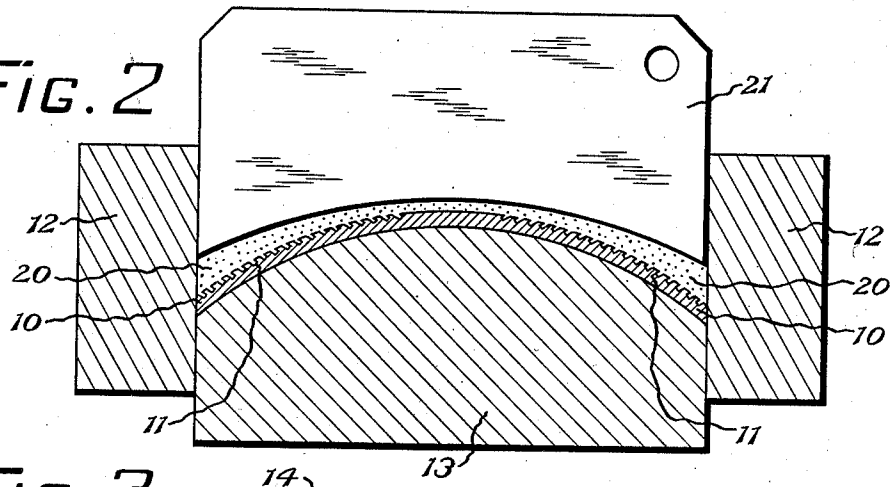
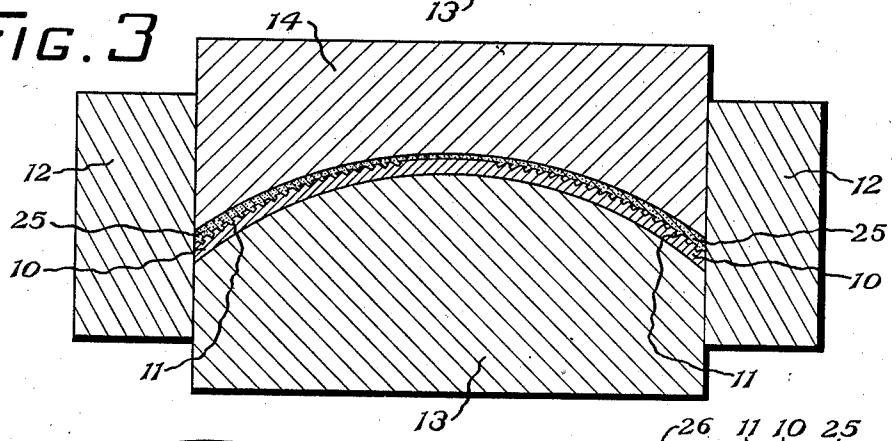


FIG. 3



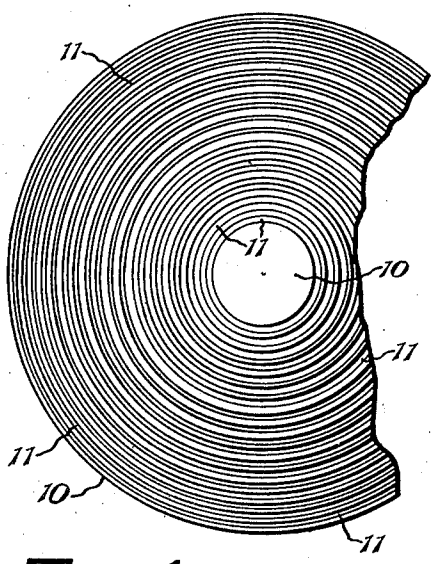


FIG. 1

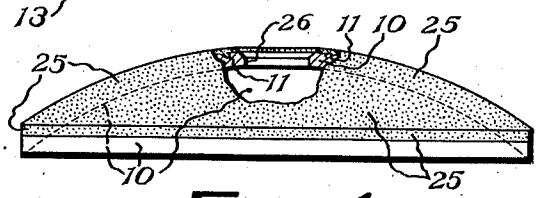
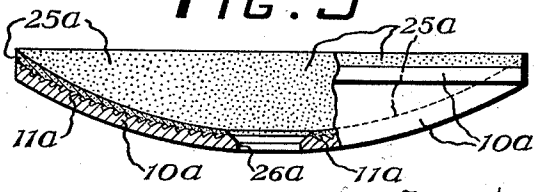


FIG. 4

FIG. 5



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UNITED STATES PATENT OFFICE

2,226,506

LAP

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Application October 2, 1940, Serial No. 359,420

6 Claims. (Cl. 51—209)

The invention relates to laps and other abrasive articles, particularly for grinding lenses.

One object of the invention is to provide a lens lap of long life. Another object of the invention is to provide a construction for a lap for lens grinding whereby substantially all of the abrasive material will be used during the life of the lap. Another object of the invention is to provide a diamond lap of spherical shape with the abrasive so distributed that little thereof is left when the lap is worn out. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangements of parts, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing showing two of many possible embodiments of the mechanical features of this invention,

Figure 1 is a plan view of a metal back for the lap;

Figure 2 is a cross-sectional view through a mold, showing the first stage of a molding operation;

Figure 3 is a cross-sectional view through the same mold, showing a later stage in the molding operation;

Figure 4 is a side elevation of a positive lap constructed according to the invention, the center part being broken away, showing the lap in cross section; and

Figure 5 is a view, partly in side elevation and partly in cross section, of a negative lap constructed in accordance with the invention.

Referring first to Figure 1, I provide a metal back 10 shaped into partial spherical form. That is to say, the metal back 10 was originally a thin disk of metal; it was pressed to partial spherical sheet form, as illustrated by comparison of Figures 1, 2 and 3. It can be described as a uniform thickness shell with similar spherical surfaces, one concave, the other convex, the surfaces being bounded by small circles (of the sphere). Also since the spherical surface to either side of a plane through a sphere is referred to as a one base zone, the metal back 10 can be referred to as a shell bounded by equal one base zones, or a one base zone shell, or simply a zonal shell.

Brass is a very satisfactory metal for the back 10 but other metals may be used, such as copper, bronze, aluminum, and various kinds of steel and iron. With a lathe tool or the like, I form a number of circular grooves 11 in the back 10. Preferably these grooves are concentric, their center being the center of the disk from which the back 10 was formed. On the other hand, it is entirely feasible to form a continuous spiral groove with equally good results. As shown, these grooves 11 undercut the material of the back 10 so that the abrasive-bond mixture will interlock therewith. Also, the grooves 11 are made with a tool inclined to the sphere axis (preferably pointing towards it) rather than parallel to the sphere axis, which also gives an interlocking construction.

As shown in Figure 3, I provide suitable mold equipment, such as a mold ring 12, a bottom plate 13, and a top plate 14. The ring 12 may have cylindrical outer and inner surfaces and plane end surfaces, as shown. The bottom plate 13 is a right circular cylinder modified by a one base zone at one end. The top plate 14 is likewise a right circular cylinder modified by a one base zone. However, the spherical zone of the bottom plate 13 is convex while the spherical zone of the top plate 14 is concave.

I provide a suitable mixture 20 of diamond abrasive and bond. For bond I may use powdered "A" stage resin, for example phenol formaldehyde, or any one of the polyhedric alcohol-polybasic acid resins, for example glycerol phthalate, or aniline formaldehyde condensed in the presence of a strong acid with or without modifying ingredients, or methyl methacrylate preferably hardened with a suitable cross-linking agent, for example up to 30% of methacrylic acid or other suitable synthetic resin. On the other hand, I may also use metal powders to form, after pressing and sintering, a metal bond. Preferable metal bonds are disclosed in my Reissue Letters Patent No. 21,165. Excellent results in actual practice are achieved using of the order of 20% tin, the remainder copper. The tin and copper can be used in the form of finely divided powders which are mixed in a suitable mixing machine with each other and then with the diamond abrasive.

Referring now to Figure 2, I place the metal back 10 upon the bottom plate 13 with the ring 12 surrounding the back 10 and bottom 13. I then introduce the abrasive-bond mixture 20 on top of the back 10. With a shaped scraper 21 which is a piece of sheet metal the bottom side of which is a secanted circle, I level the abrasive-bond mixture 20 to form a one base zone top surface.

A particular feature of the invention resides in formation of a final lap wherein the spherical radius of the abrasive surface is different from

the spherical radius of the underlying surface of the back plate 10. In the case of a positive lap, the spherical radius of the abrasive surface will be geeater than that of the underlying zone of the back plate 10. In the case of a negative lap, the spherical radius of the abrasive surface will be less than that of the underlying zone of the back. In each case, in the final article, the abrasive layer 25 is thicker at the periphery than in the center. In fact, the molding operation is carried on so as to produce an abrasive coating on the metal back plate 10 of a substantial finite thickness at the periphery, which thickness decreases by uniform amounts as the center is approached and (theoretically) drops to practically zero at the center. Thus the two zones are practically tangent and they have a common polar axis identical with the axis of the mold but their spherical radii are of different lengths, as stated.

Having thus distributed the abrasive-bond mixture 20 in the mold upon the back plate 10 by rotating a shaped scraper 21, I apply the top plate 14. The mixture in the mold is then subjected to a pressure of usually several tons per square inch to pack the mixture onto the backing 10, interlocking it with the grooves 11. The mold is then stripped and the article placed in an oven or furnace to mature or sinter the bond. In the case of phenol formaldehyde, a temperature of 175° C. over four or five hours will mature the bond to the irreversible "C" stage. In the case of a metal bond, which is disclosed in my above numbered reissue patent, that is to say, the copper-tin bond, a hydrogen atmosphere furnace is preferably used and a sintering temperature of 600° C. may be employed. For other bonds, the technique is that of maturing the bond according to methods known in the arts.

In order to attach the lap to a lens lapping machine, it is desirable to form a central hole 26 which may be countersunk, as shown. For that reason, it is unnecessary to extend the grooves 11 quite to the center of the back plate 10. This central hole 26 can best be formed after the abrasive material has been molded in place. Since all of the zonal surfaces are now between parallel cutting planes, they may be referred to as two base zones, but as the cutting of the central hole may in some cases be dispensed with, I may refer to the surfaces generically as zones.

Figure 5 discloses a back plate 10*a* with grooves 11*a* made with a lathe tool facing away from the polar axis of the zone surface, giving a good interlocking action for a negative lap, that is, a concave surface. The back 10*a* is the same as the back 10 excepting that the grooves are formed on the opposite side and incline differently, as stated. The abrasive coating 25*a* has an outer zone surface which has a smaller radius than that of the concave zone face of the back 10*a*. However, in the case of the negative lap of Figure 5 as well as in the case of the positive lap of Figure 4, the abrasive coating is thickest at the periphery of the lap and diminishes toward the center. The lap of Figure 5 has a countersunk central hole 26*a*.

To distinguish between zonal surfaces, I refer to the surfaces of the base and the abrasive portion which contact each other as the inside surfaces, the others being the free or outside surfaces.

In the use of optical laps, either the lap or the work piece is revolved. The greatest relative motion is at the periphery and the relative motion diminishes toward the center. In fact, it may be stated that the angular velocity of the abrasive action is proportional to the radius of any given point at that point. Therefore, the greatest wear will be at the periphery and the wear will diminish as the center is approached. Therefore, laps made according to my invention are economical because valuable diamonds are not wasted in the center portion. As laps made according to the present invention are used, their shape is gradually changed but since various sizes of laps will be kept on hand for making various shapes of lenses, due account can be made of the change in curvature and the lap when new may be useful for lapping lenses of a certain diopter, while later on it may be useful for lapping lenses of different diopters.

The advantage of using a zonal shell for the base instead of using a solid zone is that duplicates can quickly be made by a metal pressing operation. That is to say, a piece of sheet brass can be pressed to zonal shell shape between two dies shaped like the mold between plate 13 and top plate 14 except that they should have the same spherical radius. Furthermore, with the zonal shell base, the final article is lighter.

It will thus be seen that there has been provided by this invention an article and a method in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As various possible embodiments might be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A lap comprising an abrasive layer bounded by zones with a common polar axis, the spherical radii of the zones being different so that the abrasive layer is thicker at the periphery and diminishes in thickness as the pole of the zones is approached, and a non-abrasive backing integral with the abrasive layer, the abrasive layer constituting comminuted abrasive material and a bond therefor.

2. A lap according to claim 1 in which the base is a zonal shell.

3. A lap according to claim 1 in which the abrasive layer and the base are interlocked by grooves in the zonal surface of the base, the grooves being approximately circles concentric with each other, the center being the polar axis of the zone and the grooves having a side wall which is not parallel to the polar axis of the zone.

4. A lap comprising a zonal shell of metal having one zonal surface modified by substantially concentric grooves whose center is the polar axis of the zonal shell, the grooves being undercut as by being formed by rotating the zonal shell on its polar axis and cutting the grooves with a tool inclined to said axis, and a layer of abrasive material constituting comminuted abrasive bonded together, integrally secured to the zonal shell with said abrasive material in said grooves, and the free abrasive surface of the abrasive material being a zone of different spherical radius than the zones of the zonal shell, the abrasive material being thicker at the periphery than towards the center of the lap.

5. A lap according to claim 4 in which the inside zonal surface of the shell and the outside

zonal surface of the abrasive material are tangent at the poles.

6. Method of making an optical lap comprising rotating a metal zonal shell on its polar axis, cutting grooves in said zonal shell with a lathe tool inclined to the polar axis, placing the zonal shell in a mold, distributing over the grooved zone of the zonal shell a mixture of comminuted abrasive and bond, spreading the mixture with a spreader whose spreading edge is a secanted circle by rotating the spreader, pressing the mixture with a mold top plate which has a bottom zonal surface with a spherical radius different from that of the zonal radius of the zonal shell and forming a thicker layer of abrasive and bond at the periphery of the zonal shell, then maturing the bond to form an integral article.

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