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Europäisches Patentamt
European Patent Office
Office européen des brevets

⑪ Publication number:

0 054 368
B1

⑫

EUROPEAN PATENT SPECIFICATION

⑬ Date of publication of patent specification: **21.05.86**

⑭ Int. Cl.⁴: **B 24 D 11/00**

⑮ Application number: **81305599.3**

⑯ Date of filing: **26.11.81**

⑰ Improvements in or relating to a smoothing pad.

⑱ Priority: **28.11.80 GB 8038235**

⑲ Date of publication of application:
23.06.82 Bulletin 82/25

⑳ Publication of the grant of the patent:
21.05.86 Bulletin 86/21

㉑ Designated Contracting States:
DE FR GB IT SE

㉒ References cited:
US-A-2 804 733
US-A-2 907 146
US-A-3 324 608
US-A-3 353 308
US-A-4 019 289

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Courier Press, Leamington Spa, England.

EP 0 054 368 B1

Description

The invention relates to lens smoothing pads for smoothing the surfaces of generated lenses to prescription curvature geometrics.

Over the years, various methods of smoothing lenses have been employed using smoothing tools and abrasive slurry. In one such method, a smoothing tool of cast iron was used, the tool being formed with a smoothing face conforming to the prescription curvature of the desired lens. However, the abrasive slurry abraded the smoothing face of the tool as well as the lens and this resulted in the production of defective lenses and frequent and costly re-truing of the smoothing face of the tool. This obviously made accurate lens surfaces expensive to achieve.

It was eventually proposed to use a smoothing pad between the smoothing face of the tool and the lens, such pads conforming to and protecting the smoothing face and being easily replaceable. The use of such pads is now normal practice. The pads are formed from a variety of materials such as metal foil, perforated zinc, annealed woven wire, tempered expanded steel or non metallic materials. In use, the pads are generally adhered to the smoothing face of the tool and are usually formed as a multi-slotted flat element which enables them to conform to the curvature of the smoothing face. The adhesive may be of a contact type applied to the back of the pad and protected by a peel-off backing paper.

It has been found that smoothing pads co-operate better with the slurry than the smoothing face of the tool and provide the optimum conditions necessary to smooth lenses rapidly and accurately to the required curvature. However, the pad itself is obviously subject to wear during smoothing operations and, if such wear becomes excessive, inaccurate lenses are produced. Moreover, if the pad wears through at any point, the curved face of the smoothing tool will once again be subject to wear.

It has been proposed to overcome such difficulties by forming in the smoothing surface of the pad a series of wear indicating grooves which, in transverse cross section, have parallel side walls. As the pad wears, the depth of the groove decreases and, when any groove disappears, it is immediately apparent to the machine operator that the pad has worn and needs replacing. A pad of this type is described in US Patent No. 4,019,289.

Whilst the use of parallel side walls could be expected to indicate that wear has occurred, it is only when a groove or part thereof has completely disappeared that wear is readily noticeable. This is because the eye cannot easily detect changes in depth of the parallel sided shallow grooves particularly where there is a desirable residual slurry in the grooves. In the foregoing US Patent Specification, it is proposed to use grooves of incrementally increasing depths across the pad. In this way, the shallowest groove will supposedly disappear first and will provide an

early indication of wear. Whilst an early indication of wear will be obtained if the wear occurs in the shallow groove area, the incremental depth arrangement will not help if the wear is localised in the area of the deepest grooves. In such a case, defective lenses can be produced as the operator concentrates on the shallowest grooves and believes that no significant wear is taking place on the pad. Moreover, the depths of the shallowest grooves may be obscured by residual slurry. Another disadvantage of using grooves having parallel side walls is that sharp lines of transition are defined between the walls and the smoothing surface of the pad. The grooves constitute reservoirs for the slurry, and it is desirable to encourage flow of slurry from the grooves on to the smoothing surface as flow of slurry between the lens and the smoothing pad tends otherwise to be restricted once relative movement therebetween takes place. However the sharp lines of transition tend to have a scraping effect which not only discourages flow of slurry from the grooves but tends to scrape the surface of the lens clear of slurry.

An object of the present invention is to provide a smoothing pad which overcomes the foregoing disadvantages and, according to the invention, there is provided a lens smoothing pad for mounting on a rigid curved smoothing tool and having a working surface which, in use, conforms to the surface curvature of the tool, a plurality of wear indicator grooves in said working surface each of which extends across the pad from one edge thereof to another edge for indicating wear of the working surface of the pad, and constituting a reservoir for an abrasive slurry used with the pad, each groove comprising a flat bottom surface and side walls extending from the flat bottom surface to the working surface of the pad to provide an indication of wear of the working surface, characterised in that the side walls of each groove are convex between the flat bottom surface of the groove and the working surface whereby the groove diverges towards the working surface so that the width of the groove will diminish as the working surface wears to provide said indication of wear, and said convex side walls provide a gradual transition from the associated groove to the working surface whereby, in use, the abrasive slurry will be encouraged to flow from each groove on to the working surface.

With that arrangement, a change in a dimension of the depression in such a direction is readily apparent at every stage of wear as the change is more easily detected than a mere reduction in depth of a very shallow groove even where there is a desirable residual slurry in the depression and the slurry is positively encouraged to flow from each groove on to the working surface.

Preferably the side walls of each groove are convex throughout the distance between the flat bottom surface of the groove and the working surface.

The side walls of the groove may be of part

circular cross section.

The centre of curvature of each convex side wall preferably lies further from the working surface of the pad than said bottom surface of the associated groove.

The pad may comprise a metal foil in which said grooves are formed by rolling so as to form recesses in an undersurface of the pad, said undersurface having a layer of adhesive thereon for attaching the pad to a surfacing tool and said recesses being arranged to receive adhesive which is displaced when the pad is applied to the surfacing tool.

Preferably said wear indicator grooves are arranged so that wear indicator grooves in one portion of the working surface are transverse to wear indicator grooves in another portion of the working surface. At least a portion of each such wear indicator groove may follow a curved path in plan. In such a case, a wear indicator groove in one portion of the working surface may be connected by a further groove to a wear indicator groove in another portion of the working surface.

Smoothing pads in accordance with the invention will now be described by way of example with reference to the accompanying drawings in which:—

Figures 1 to 3 are plan views of three different smoothing pads having grooves formed therein in accordance with the invention;

Figure 4 is a cross-section through part of a smoothing pad having parallel sided grooves and illustrating slurry flow as a lens moves over the pad;

Figure 5 is a cross-section through part of a smoothing pad in accordance with the invention in which there is a gradual transition between the groove and the working surface of the pad to give improved slurry flow;

Figure 6 is a diagrammatic representation of the groove in the pad of Figure 5 illustrating how the width of the groove changes as the pad wears;

Figures 7 to 14 are plan views of eight smoothing pads having different arrangements of grooves formed in accordance with the invention; and

Figure 15 is a cross-section through a pad having grooves formed by rolling.

Figures 1 to 3 show typical smoothing pads made, e.g. from metal foil. Each pad has a working surface 1 and is formed with one or more slots 2, the slots enabling the pads to conform to various shapes of surfacing tools. If desired the undersurfaces 3 of each pad may be provided with a layer of adhesive (not shown) for securing the pad to the smoothing tool. The adhesive layer is protected by a peel-off backing sheet (not shown) which is removed to expose the adhesive. Each pad is formed with wear indicating grooves 6 which extend part way through the pad as shown clearly in Figure 5.

Hitherto it has been proposed to make the walls of such grooves parallel sided as shown in Figure 4 (one groove only being shown). In Figure 4 a smoothing pad 20 has parallel sided grooves 21

(one only of which is shown) and is supported by a tool 22. In use, a lens 23 is moved in random fashion over the working surface 24 of the pad and slurry S is fed to the pad to act as a smoothing medium. A certain amount of slurry S' is contained in the grooves 21 and during relative movement it is highly desirable that some of the slurry flows out of the grooves and across the pad between the lens 23 and the working surface 24. However, with the groove 21 shown in Figure 26, slurry S on the lens surface tends to be scraped off the lens by sharp lines of transition 25, 25a between the groove 21 and the working surface 24. When moving the lens in the direction M shown the slurry is scraped off at 25 and when moving the lens in the opposite direction the slurry is scraped off at 25a. Although a certain amount of slurry S' will flow out of the groove during movement of the lens, the scraping action tends to inhibit the usefulness of such flow.

Greatly improved slurry flow from the grooves can be obtained by using a pad in accordance with the invention having grooves 6 of the type shown in Figure 5. In that Figure, the groove 6 has a flat bottom 31 and arcuate side walls 32, 32a. The side walls form a gradual transition between the bottom of the groove 6 and the working surface 33 of the pad as opposed to the sharp lines of transition 25, 25a in Figure 4. During movement of the lens 23 across the pad in the direction M shown, the curved wall 32 encourages the slurry S¹¹ to be drawn out of the groove by the moving lens and does not have the scraping effect of the sharp transitions. The wall 32a has a similar effect when the lens is moved in the opposite direction. This arrangement is particularly advantageous and reduces the likelihood of dry areas void of slurry occurring on the working surface.

In accordance with the invention, the arrangement shown in Figure 5 provides an indication of wear by reduction of width. That point is illustrated well in Figure 6. Prior to wear, the maximum width of the groove is indicated at C. After wear, the width W of the groove is as follows:—

$$W = \sqrt{C - 2RD - D^2}$$

where

C = Width of groove before wear has occurred

D = amount of wear

R = radius of curved side wall.

Of course, once wear has occurred, the transition tends to sharpen but within the useful life of the pad the surface of the pad is still substantially tangential to the curved side walls and the scraping action illustrated in Figure 4 is still avoided. The groove 6 also provides a multiplier wear facility by which the rate of change of groove width is greater than the rate of pad surface wear.

Pad grooves can be cut into the pad but such a method of forming can weaken the pad as the grain of the foil is severed. We prefer to form the grooves by rolling which deforms rather than

severs the grain and substantially preserves the strength of the pad. A pad formed in that way is shown in Figure 15 and recesses 9 are formed therein during the rolling operation. Displaced adhesive is received by the recesses 9 to reduce the risk of distorting the bottom of the wear indicating groove 6 when the pad is applied to a surfacing tool.

In Figures 7 to 14 various groove patterns are illustrated which provide reservoirs and facilitate distribution of slurry over the working surface of pads in accordance with the invention.

In Figures 1 to 3 and in the aforesaid US specification, the grooves are completely straight and parallel and slurry flow through them is at its best only when the relative movement between the lens and pad is in the longitudinal direction of the grooves.

With the pads shown in Figures 7 to 14 we have provided grooves generally indicated at 6 which extend in various directions to improve slurry distribution during random pad movement. Therefore even when the movement is transverse to one groove, there will be some other groove along which slurry will flow reasonably freely. For example in Figures 7 and 8 if movement is in direction X transverse to grooves 6A and 6B, slurry will be encouraged to flow along at least groove sections 6C and 6D. In Figures 8, 10, 12 and 14 selected grooves are interconnected to central ducts 10 to improve distribution of slurry from one lobe of the pad to another.

As well as providing for improved slurry flow, the provision of a multiplicity of grooves increases the availability of slurry because the grooves form a reservoir for slurry during movement of the pad/lens.

Although pads made in accordance with the present invention are easily checked for wear by the eye, a suitable checking instrument may be used to detect width variation even before it becomes apparent to the naked eye.

Pads in accordance with the invention may be formed from material other than metal and need not be provided with an adhesive backing.

Claims

1. A lens smoothing pad for mounting on a rigid curved smoothing tool (22) and having a working surface (33), which, in use, conforms to the surface curvature of the tool, a plurality of wear indicator grooves (6) in said working surface each of which extends across the pad from one edge thereof to another edge for indicating wear of the working surface of the pad, and constituting a reservoir for an abrasive slurry (S^{11}) used with the pad, each groove comprising a flat bottom surface (31) and side walls (32) extending from the flat bottom surface to the working surface of the pad to provide an indication of wear of the working surface, characterised in that the side walls (32) of each groove are convex between the flat bottom surface (31) of the groove (6) and the working surface (33) whereby the groove di-

verges towards the working surface so that the width of the groove will diminish as the working surface wears to provide said indication of wear, and said convex side walls (32) provide a gradual transition from the associated groove (6) to the working surface (33) whereby, in use, the abrasive slurry (S^{11}) will be encouraged to flow from each groove on to the working surface.

2. A lens smoothing pad according to Claim 1 characterised in that the side walls (32) of each groove (6) are convex throughout the distance between the flat bottom surface (31) of the groove and the working surface (33).

3. A lens smoothing pad according to Claim 1 or 2 characterised in that said convex side walls (32) are of part circular cross section.

4. A lens smoothing pad according to Claim 2 or 3 characterised in that the centre of curvature of each convex side wall (32) lies further from the working surface (33) of the pad than said bottom surface (31) of the associated groove (6).

5. A lens smoothing pad according to any preceding claim characterised in that the pad comprises a metal foil in which said grooves (6) are formed by rolling so as to form recesses (9) in an undersurface of the pad, said undersurface having a layer of adhesive thereon for attaching the pad to the surfacing tool (22) and said recesses being arranged to receive adhesive which is displaced when the pad is applied to the surfacing tool.

6. A lens smoothing pad according to any preceding claim characterised in that said wear indicator grooves (6) are arranged so that wear indicator grooves (6) in one portion of the working surface are transverse to wear indicator grooves (6) in another portion of the working surface (33).

7. A lens smoothing pad according to Claim 6 characterised in that at least a portion of each wear indicator groove (6) follows a curved path with the pad viewed in plan.

8. A lens smoothing pad according to Claim 7 characterised in that a said wear indicator groove (6) in one portion of the working surface is connected by a further groove (10) to a wear indicator groove (6) in another portion of the working surface.

Patentansprüche

1. Schleifunterlage für Linsen zur Montage an einem starr gekrümmtem Schleifwerkzeug (22), mit einer Arbeitsfläche (33), die bei Gebrauch mit der Oberflächenkrümmung des Werkzeuges übereinstimmt, mit einer Vielzahl von den Abrieb anzeigenden Nuten (6) in der Arbeitsfläche, von denen sich jede von einem Ende zu einem anderen Ende über die Unterlage erstreckt und die den Abrieb der Arbeitsfläche der Unterlage anzeigen und ein Reservoir für ein mit der Unterlage verwendetes Schleifmedium (S'') bilden, wobei zur Anzeige des Abriebs der Arbeitsfläche jede Nut eine ebene Grundfläche (31) und Seitenwände

(32) aufweist, die sich von der ebenen Grundfläche zur Arbeitsfläche der Unterlage erstrecken, dadurch gekennzeichnet, daß die Seitenwände (32) jeder Nut konvex zwischen der ebenen Grundfläche (31) der Nut (6) und der Arbeitsfläche (33) verlaufen, wobei die Nut zur Arbeitsfläche hin derart divergiert, daß zur Anzeige des Abriebs sich die Breite der Nut durch den Abrieb der Arbeitsfläche vermindert, und daß die konvexen Seitenwände (32) allmählich von der zugeordneten Nut (6) in die Arbeitsfläche (33) übergehen, wodurch bei der Benutzung das Schleifmedium (S") aus jeder Nut auf die Arbeitsfläche gefördert wird.

2. Schleifunterlage nach Anspruch 1, dadurch gekennzeichnet, daß die Seitenwände (32) jeder Nut (6) über den gesamten Abstand zwischen der ebenen Grundfläche (31) der Nut und der Arbeitsfläche (33) konvex sind.

3. Schleifunterlage nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die konvexen Seitenwände (32) teilweise einen runden Querschnitt aufweisen.

4. Schleifunterlage nach Anspruch 2 oder 3, dadurch gekennzeichnet, daß der Mittelpunkt der Krümmung jeder konvexen Seitenwand (32) weiter von der Arbeitsfläche (33) der Unterlage als von der Grundfläche (1) der entsprechenden Nut (6) entfernt ist.

5. Schleifunterlage nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Unterlage eine Metallfolie aufweist, in der die Nuten (6) durch Walzen derart ausgeformt sind, daß an der Unterseite der Unterlage Einbuchtungen (9) ausgebildet sind, wobei die Unterseite zur Befestigung der Unterlage an dem flächenbildenden Werkzeug (22) eine Klebeschicht trägt und die Einbuchtungen derart angeordnet sind, daß sie Kleber aufnehmen, der beim Anbringen der Unterlage an dem flächenbildenden Werkzeug austritt.

6. Schleifunterlage nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die den Abrieb anzeigenden Nuten (6) derart angeordnet sind, daß den Abrieb anzeigende Nuten (6) in einem Teil der Arbeitsfläche quer zu den Abrieb anzeigenden Nuten (6) in einem anderen Teil der Arbeitsfläche (33) ausgerichtet sind.

7. Schleifunterlage nach Anspruch 6, dadurch gekennzeichnet, daß wenigstens ein Teil jeder der den Abrieb anzeigenden Nuten (6) einen gekrümmten Verlauf aufweist, der der Außenkontur der Unterlage in Draufsicht entspricht.

8. Schleifunterlage nach Anspruch 7, dadurch gekennzeichnet, daß eine den Abrieb anzeigende Nut (6) in einem Teil der Arbeitsfläche mittels einer weiteren Nut (10) mit einer den Abrieb anzeigenden Nut (6) in einem anderen Teil der Arbeitsfläche verbunden ist.

Revendications

1. Tampon de polissage de lentille destiné à

être monté sur un outil de polissage (22) rigide et cintré et présentant une surface de travail (33) qui, à l'usage, se conforme à la courbure de l'outil, une pluralité de rainures indicatrices d'usure (6) dans ladite surface de travail, chacune d'entre elles s'étendant de l'une à l'autre extrémité du tampon pour indiquer l'usure de la surface de travail du tampon et constituant un réservoir de boue abrasive (S¹¹) utilisée avec le tampon, chaque rainure comprenant une surface de base plate (31) et des parois latérales (32) s'étendant depuis la surface de base plate jusqu'à la surface de travail du tampon pour fournir une indication sur l'usure de la surface de travail, caractérisé en ce que les parois latérales (32) de chaque rainure sont convexes entre la surface de base plate (31) de la rainure (6) et la surface de travail (33), la rainure divergeant vers la surface de travail de telle sorte que la largeur de la rainure diminue quand la surface de travail s'use, afin de fournir ladite indication d'usure, et lesdites parois latérales convexes (32) fournissant une transition graduelle depuis la rainure associée (6) jusqu'à la surface de travail (33), la boue abrasive (S¹¹) étant ainsi encouragée, à l'usage, à s'écouler de chaque rainure sur la surface de travail.

2. Tampon de polissage de lentille selon la revendication 1, caractérisée en ce que les parois latérales (32) de chaque rainure sont convexes sur toute la distance entre la surface de base plate (31) de la rainure et la surface de travail (33).

3. Tampon de polissage de lentille selon les revendications 1 ou 2, caractérisé en ce que lesdites parois latérales convexes (32) sont de section transversale semi-circulaire.

4. Tampon de polissage de lentille selon les revendications 1 ou 3, caractérisé en ce que le centre de courbure de chacune des parois latérales convexes (32) se trouve plus loin de la surface de travail (33) du tampon que ladite surface de base (31) de la rainure associée (6).

5. Tampon de polissage de lentille selon l'une des revendications précédentes, caractérisé en ce qu'il comporte une feuille métallique dans laquelle lesdites rainures (6) sont formées par laminage de façon à former des échancrures (9) dans une face inférieure du tampon, ladite face inférieure comportant une couche d'adhésif pour lier le tampon à l'outil de polissage (22) et lesdites échancrures étant prévues pour recevoir l'adhésif qui est déplacé quand le tampon est appliqué sur l'outil de polissage.

6. Tampon de polissage de lentille selon l'une des revendications précédentes, caractérisé en ce que lesdites rainures indicatrices d'usure (6) sont disposées de telle sorte que les rainures (6) dans une partie de la surface de travail sont transversales aux rainures (6) dans une autre partie de la surface de travail (33).

7. Tampon de polissage de lentille selon la revendication 6, caractérisé en ce qu'une partie au moins de chaque rainure indicatrice d'usure (6) suit un parcours en courbe avec le tampon vu en plan.

* 8. Tampon de polissage de lentille selon la revendication 7, caractérisé en ce qu'une desdites rainures indicatrices d'usure (6), dans une partie

de la surface de travail, est reliée par une autre rainure (10) à une rainure indicatrice d'usure (6) dans une autre partie de la surface de travail.

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FIG. 1

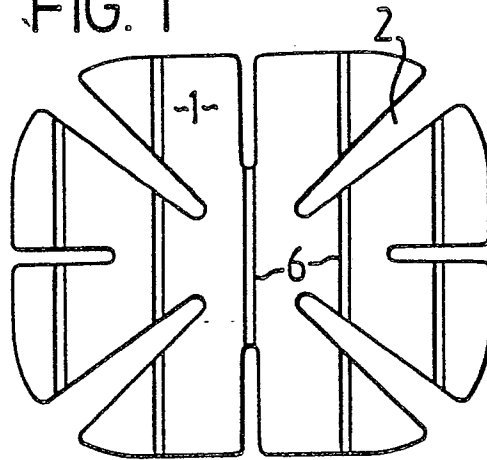


FIG. 2

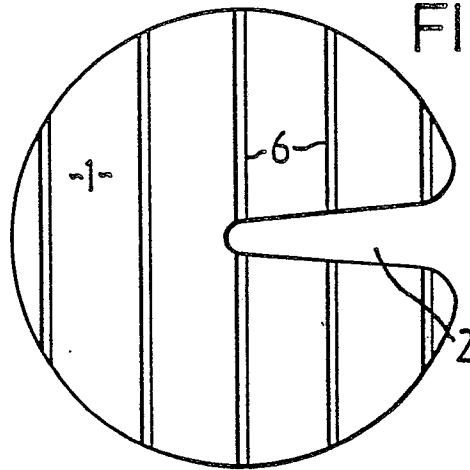


FIG. 3

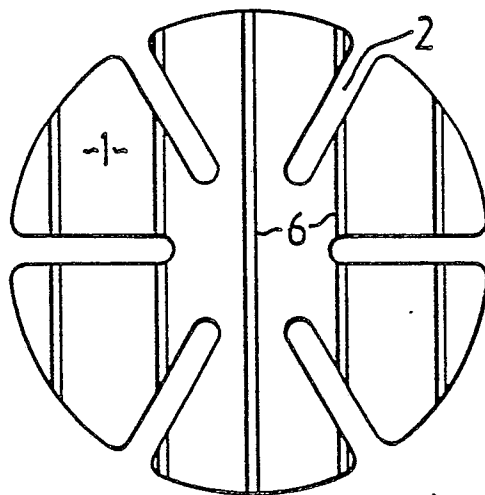


FIG. 5

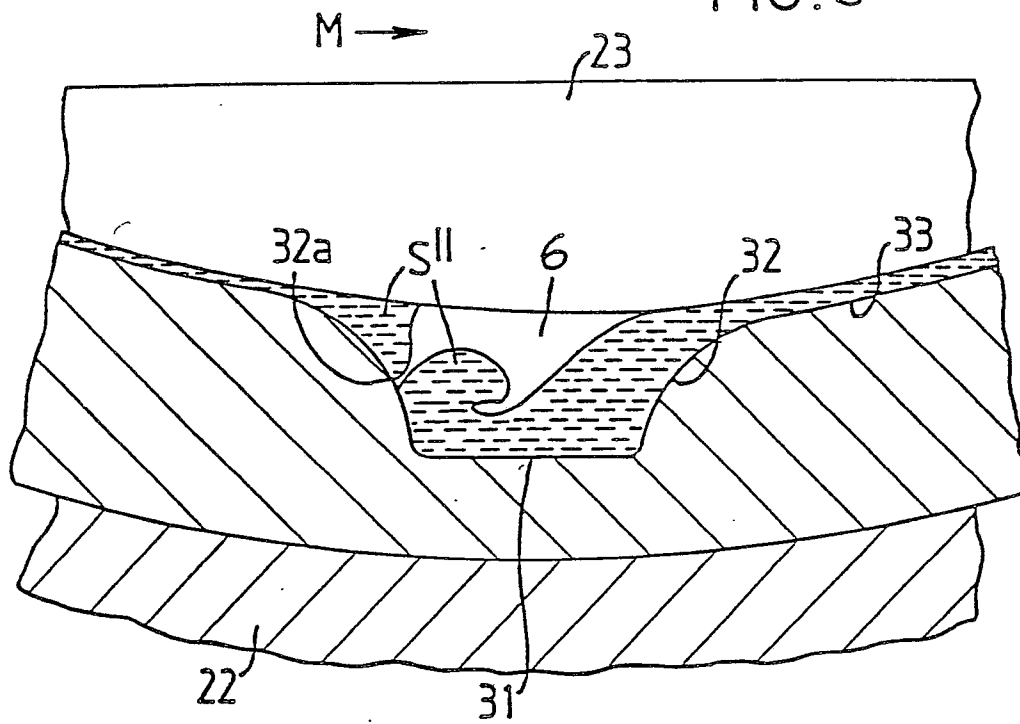


FIG. 6

