United States Patent

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[33] **Germany**
[31] **P 15 53 666.0**

[54] **SHEARING FOIL FOR A DRY-SHAVING RAZOR**
4 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **30/346.51**
[51] **Int. Cl.** **B26b 19/04**
[50] **Field of Search** 30/346.51, 346.57

[56] **References Cited**
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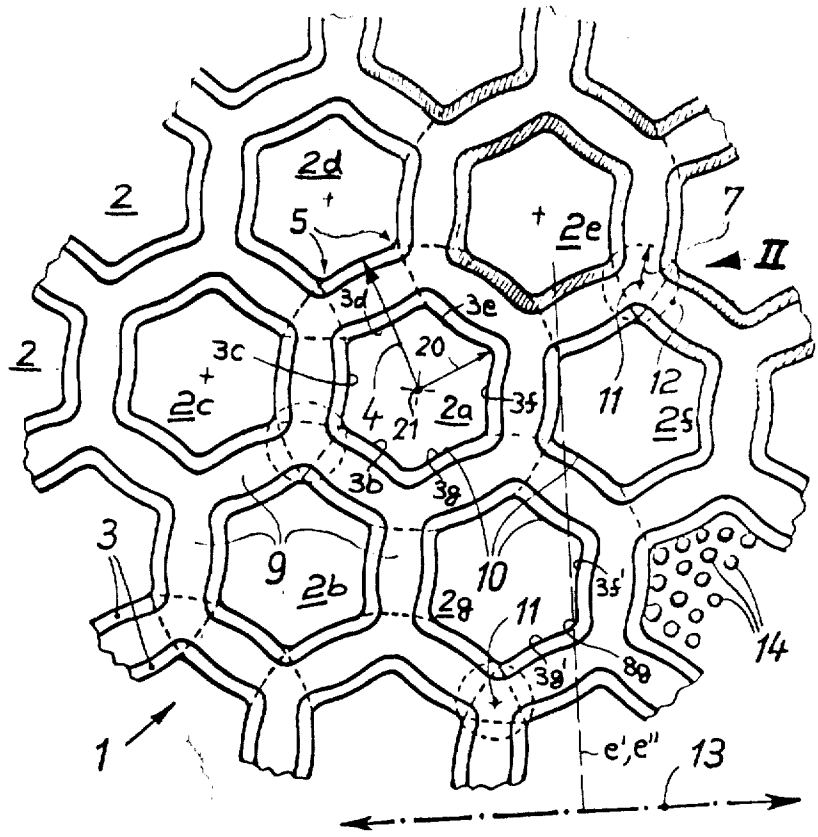
This application filed under Rule 47.

ABSTRACT: A shearing foil for a dry-shaving razor adapted to cooperate with a movable blade and provided with a multiplicity of hair-inlet openings. The openings are of generally polygonal configuration with inwardly convex arc-segmental edges adjoining one another at the vertices of the polygon. The radii of curvature of the arc segment edges exceed the radius of the opening while the centers of curvature are located externally of the opening and preferably at the centers of the nearest-neighbor openings.



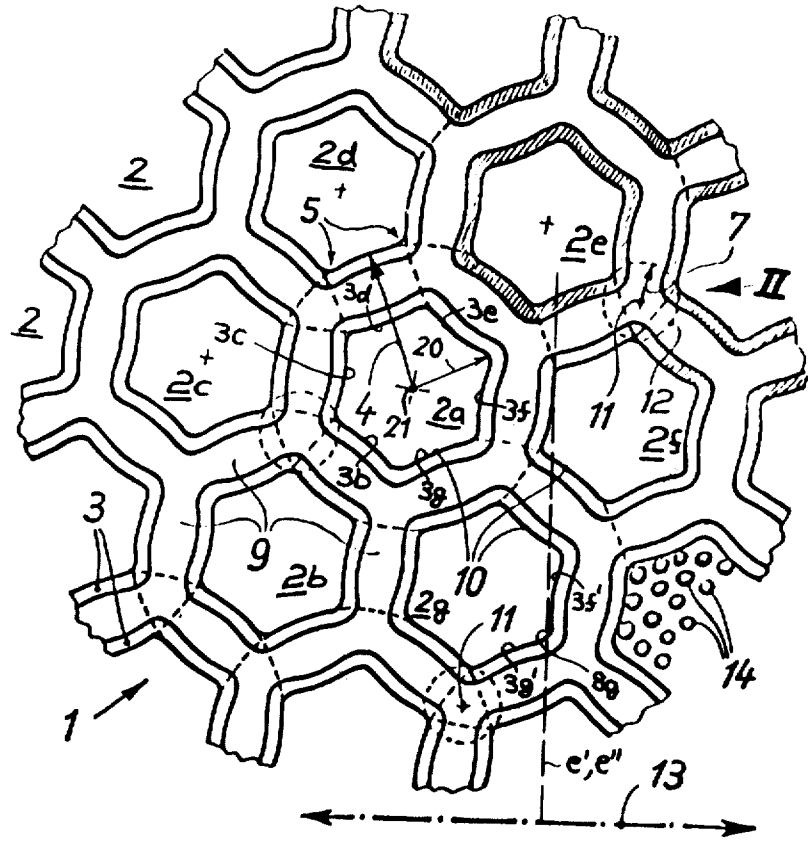


Fig. 1

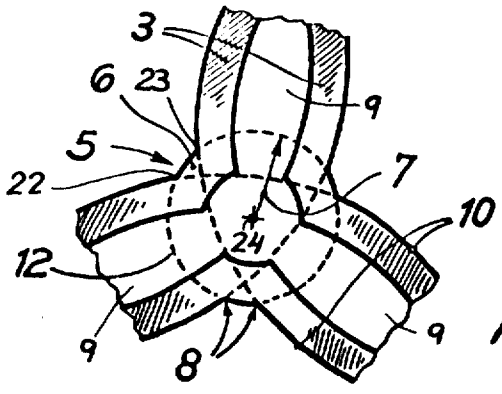


Fig. 2

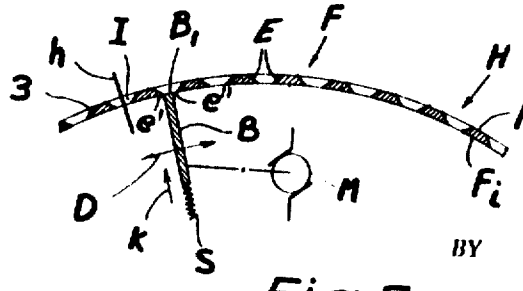


Fig. 7

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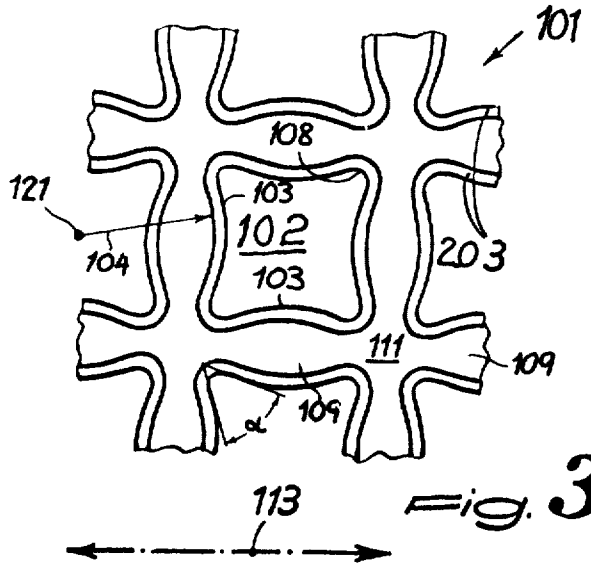

Fig. 3

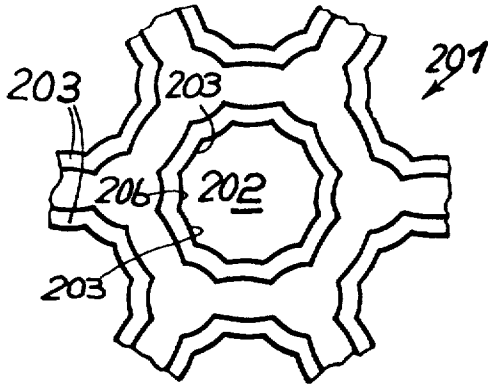

Fig. 4

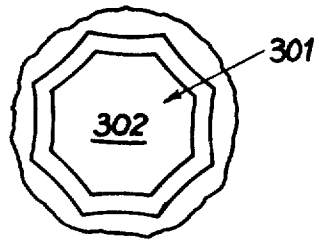

Fig. 6

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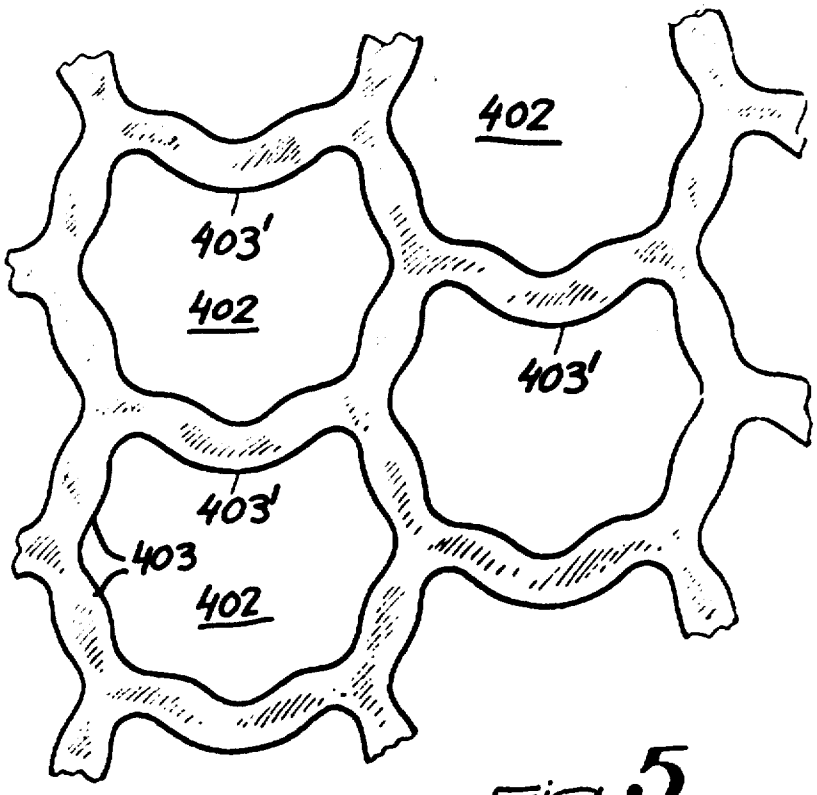

Fig. 5

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SHEARING FOIL FOR A DRY-SHAVING RAZOR

The present invention relates to improvements in shear foils for dry-shaving razors and, more particularly, to the outer member of an electric or mechanical dry-shaving razor head which sets up the whiskers at their junctions with the skin of the user and forms a stationary blade relative to which the movable blade is shiftable to sever hair passing through the openings in this head.

In addition to clipper-type dry-shaving razors, in which the hair is snipped between blades in a pincer action, it has been the practice to provide perforated shields or foils as one blade member of a dry-shaving razor. In such cases, the perforated shield or foil forms the outer member of the razor head and is substantially fixed to the body of this head, while being provided with a multiplicity of hair entry openings through which the whiskers of the user project.

Along the surface of this relatively thin sheet metal foil or shield, which is more or less deflectable to follow the contours of the user, one or more movable blades are oscillated or reciprocated to shear the hair projecting through the openings against the edges of the foil surrounding the openings. The shearing action is promoted, in accordance with conventional techniques, by inducing an inclined cut as the blade sweeps pass the respective cutting edges; thus it has been proposed to form the openings with straight-sided polygonal, e.g. hexagonal, boundaries or framing edges to insure that at least some of the edges will carry out an inclined or scissorlike cutting of the hair as the movable blade sweeps along the inner surface.

To obtain maximum inclined or scissor-cutting action, it has been found to be necessary to orient the hexagonal framing edges of the opening such that a diagonal thereof is at least approximately parallel to the direction of movement of the inner or movable cutting members. In this case, at least two opposite edges are also parallel to the direction of movement of the blade (and perpendicular to the cutting edge of the movable blade) while the remaining four edges of the hexagonal boundaries of each opening are inclined to this direction of movement.

Experience has shown that such structures are not always satisfactory and in fact that they have some significant disadvantages. For example, hairs frequently become lodged at the angular junctions of the edges of a straight-sided hexagonal or polygonal opening and are encountered by the movable blade in an impact-type of engagement which tears the hair from the skin, may pinch the skin of the user, or may damage the relatively thin foil of the movable blade. In addition, the impact causes wear at the corners of the foil and the adjacent cutting edges and thereby increases the danger of undesirable seizure of hairs in these corners.

It is, therefore, the principal object of the present invention to provide an improved shearing foil for dry-shaving razors of the character described.

Another object of this invention is to provide a shearing foil for the shaving head of an electric or mechanical dry-shaving razor which will avoid the aforementioned disadvantages, can be positioned substantially independently of the orientation of the hair-inlet openings, manifests substantially less wear along the cutting portions of the foil, and yet provides an optimal drawing-type or scissorlike cutting action.

These objects and others which will become more apparent hereinafter are obtainable in accordance with the present invention, in a shearing foil for a dry-shaving razor which is provided with a multiplicity of hair-inlet openings and is adapted to contact the skin of the user and to be swept along its opposite side by a movable blade member, generally spring biased against this inner surface of the foil and reciprocated, rotated or oscillated in contact therewith to shear the projecting hairs at edges of the openings against the movable blade.

The invention provides that the hair-inlet openings which are formed in the outer shear member of the cutting head, are framed by or outlined with a closed array of arc segments, convex in the direction of the interior of the opening and adjoining one another at corners of a polygon.

The term "multiplicity" when used in connection with the number of arc segments is intended to refer to four or more, such that the number of corners is also four or more.

The radius of curvature of the arc segments preferably differs from the radius of the opening and, advantageously, exceeds the maximum radius thereof while the centers of curvature of the arc segments can be located at the centers of the openings closest to and surrounding the openings whose edges are under consideration.

In other words, when four or six inwardly convex arcuate edges are provided to frame each opening and the junctions of these edges lie at the vertices of a four- or six-sided regular polygon (square or hexagon, respectively), each opening is surrounded by a corresponding number of nearest-neighbor openings the vertices of which constitute centers of curvature for respective edges of the opening which they surround.

According to an important feature of this invention, the junctions of the inwardly convex arc segment edges of each opening preferably are truncated by further arc segment edges which constitute bevels or the like and are also convex inwardly with an arc length generally less than the arc length of the main arc segments, although it may be equal or greater than the latter.

Consequently, the truncating or bevelling arc segments convert an acute angle junction between two principal arc segment edges into two obtuse angle junctions, i.e., the junctions between each of the principal edges and the truncating or bevelling edge. In general, it may be noted that obtuse angle junctions are preferred to acute angle junctions with the arc segment configuration of the edges of the openings is used.

The result is a reticulate structure of the shearing foil with metallic strips defining the hair-inlet openings between them and being outwardly bulging (inwardly with respect to the openings) between junctions of the strips, webs or arms of the reticulate structure.

According to another feature of this invention, the number of inwardly convex arc segment edges may be increased (with a corresponding increase in the number of vertices of the polygon at which the arc segments join) to a point well before the polygonal structure practically degenerates into a circle.

Best results have been found with four-sided, six-sided eight-sided or twelve-sided openings. An analysis of the described configuration will show that when a blade sweeps along a perforated surface of the character described, it cannot encounter a hair in a position in which the aforedescribed incliner shear or scissor action will not occur. Since the arc-seg configuration allows no edge to be precisely perpendicular to the movable blade edge or precisely parallel to the direction of displacement of the latter, the inclined shearing is inherent at all locations.

An additional advantage of the present system is that the convexity of the cutting edges of the foil provides an increased cutting length with respect to foils having the same number of openings and straight edges. Consequently, a dry-shaving razor in accordance with the present invention not only operates fast but also provides a better, cleaner shave. The latter advantage has been found to result from the fact that, when the aforedescribed configuration of the openings is used, there is less of a tendency of the skin of the user to bulge into the openings and therefore a substantially reduced tendency toward nicking of the skin.

According to an important feature of the present invention, of independent significance, a shearing foil serving as the outer cutting member of a dry-shaving razor head comprising a multiplicity of hair-inlet openings in approximately a hexagonal close-packed array with intervening bands, strips or ribs joining together at three-member junctions (adjoining at angles of 120°) and defining the edges of the openings. The edges are inwardly convex arc segments as mentioned earlier and lie along an array of overlapping circles whose radii are all

equal and constitute the radius of curvature of the arc segmental edges; the centers of curvature of the sides of the openings are the centers of the nearest-neighbor openings. The overlapping portions of the circles in this arrangement define the intervening webs of sheet metal.

In accordance with this aspect of the invention, acute-angle junctions at each of the vertices of the hexagon corresponding to the corners at which the arc-segmental edges adjoin, are truncated with a further arc-segmental portion or edge which is also convex inwardly. The centers of curvature of these truncating edges lie at the three-arm junctions of the webs and may also be the centers of a circle substantially wholly received within the overlapping circles of three nearest-neighbor openings. The radius of curvature of the truncating edges is, of course, the radius of this relatively small circle.

According to still another feature of this invention, the shearing foil is provided with a uniform distribution of four-sided hair-inlet openings, the edges of which are defined by inwardly convex arc segments, the openings being arrayed in a square pattern so that the junctions of the intervening webs are at right angles with one another. It has been found to be advantageous to round off the corners of the arc-segmental edges defining each hair-inlet opening and, in addition, merge these corners into the edges such that they include angles of less than 90° at the corners.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is an enlarged plan view of a portion of a shearing foil for the cutting head of a dry-shaving razor in which a hexagonal pattern of hair-inlet openings is used;

FIG. 2 is an enlarged detail view of the region II of FIG. 1;

FIG. 3 is a view similar to FIG. 1 but showing a shearing foil having four-sided hair-inlet openings;

FIG. 4 is a view similar to FIG. 1 in which the hair-inlet openings are twelve-sided;

FIG. 5 is a plan view, drawn to an enlarged scale of a foil using an irregular configuration of hair-inlet openings;

FIG. 6 is a view similar to FIG. 4 of a foil with eight-sided openings; and

FIG. 7 is a diagrammatic cross section transverse to the foil to show its relationship to the movable blade member.

Referring first to FIG. 7, it can be seen that the cutting head of a dry-shaving razor which is represented at H, may comprise a foil F whose outer surface F_o is adapted to engage the skin of the user and is provided with hair-inlet openings I in one of which a hair *h* is shown to project. The openings I are defined between edges E which are beveled inwardly as shown in FIG. 7 to provide the stationary shearing blades. Along the inner surface F_i of the foil F, a movable blade member B is shown to be oscillatable in the direction of an arrow D by the shaver motor M. The blade B is provided with a T-shaped head B_1 whose edges *e'* and *e''* cooperate with the beveled edges E to shear the hairs *h* which project through the openings I as the blade B sweeps across the openings. A spring S biases the blade B against the foil F in the direction of the arrow K.

The foils of FIGS. 1–6 may constitute the foil F of the shaver head H shown in FIG. 7.

In FIGS. 1 and 2, there is shown the beveled construction of a shearing foil 1 in accordance with the present invention, this foil being adapted to cooperate with a movable blade edge *e'*, *e''* as described in connection with FIG. 7. The foil has a reticulate structure with a multiplicity of hair-inlet openings 2 in a hexagonal close-packet array in which each opening (e.g. 2*a*) is surrounded by six nearest-neighbor openings 2*b*, 2*c*, 2*d*, 2*e*, 2*f* and 2*g*.

Each of the openings 2 is, in plan view, bounded by a plurality of inwardly convex arc-segmental edges 3 with radii of curvature 4 exceeding the maximum radius 20 of the opening. The centers of the openings are represented at 21. In the configuration shown in FIG. 1, the edges of each opening, i.e., the edges 3*b*, 3*c*, 3*e*, 3*f* and 3*g* of the opening 2*a* have centers of curvature coinciding with the centers of the openings 2*b*–2*g* respectively.

Angle junctions 5 are provided between the adjoining edges 3 of each opening and lie at the vertices of a regular polygon, namely a hexagon in the system of FIG. 1. These angle junctions are truncated by a relatively short arc segment 6 which is also convex inwardly and bridges two adjoining edges 3 as shown in FIG. 2 so that the angles 22 and 23 between each edge 3 and the arc segment 6 will be an angle. These acute angles are also represented at 8 in FIG. 2. The arc segments 6 have a center of curvature 24 coinciding with the center of a junction of the three webs 9 separating the nearest-neighbor openings, the radius of curvature being represented at 7 and the circle along which the arc segments 6 lie, being represented at 12.

According to an important feature of this invention, the array of six-sided openings 2 and the separating webs 9 is defined geometrically by a plurality of overlapping circles 10 of identical radius 4, the circumferences of these circles each defining the six arc segments of six nearest-neighboring openings, while the region of overlap with these nearest-neighbor openings defines the configuration of the webs 9. The latter adjoin one another at junctions which are represented at 11 and extend therefrom at angles of substantially 120° with one another. The circles 12 are, of course, wholly encompasses in the three-circle overlap region of three nearest-neighbor circles 10. Hair enters the openings 2 (as shown at 14 in FIG. 1) and is engaged by the blade edge *e'*, *e''*, as it is reciprocated or oscillated as represented at arrow 13. When the motion is to the right (FIG. 1), any hair lying along the edge 3*g'* of the opening 2*g* will be sheared at an acute angle while hairs lying along the edge 3*f'* or at the junction 8*g* will likewise meet the blade *e'*, *e''* at an incline and cooperate therewith in scissorlike action. Neither tearing nor impacting occurs and squeezing and pinching is avoided.

FIG. 3 shows a modified configuration of the foil 101 wherein the openings 102 have inwardly convex arc-segmental edges 103 which adjoin one another at the vertices of a square. Each edge 103 has a radius of curvature 104 and a center of curvature 121 located in the center of an adjoining opening. Each opening also has four nearest-neighbor openings while the webs 109 adjoin one another at the junction 111 in a maltese cross configuration. Here, too, the movement of the blade B (FIG. 7) is represented by an arrow 113. The corners 108 at the junctions of the edges are here shown to be inwardly convex and to define acute angles α of less than 90°.

In FIG. 4, the openings 202 of the foil are twelve-sided with edges 203. In this foil arrangement, each opening 202 is surrounded by six nearest-neighbor openings but the corners of the hexagon are truncated and provided with inwardly convex edges 206 equal in length to the edges 203 so that the foil 201 gives the appearance of a twelve-sided array. In FIG. 6, the foil 301 is shown to have openings of regular octagonal configuration as represented at 302. In FIG. 5, the regular rectagon of FIG. 6 is provided with one reversed or inverted corner turned out to be part of the side 403' while the remaining edges 403 of the openings 402 correspond to the edges of the octagonal opening 302. The result is a seven-sided structure.

The improvement described and illustrated is believed to admit of many modifications within the ability of persons skilled in the art, all such modifications being considered within the spirit and scope of the invention except as limited by the appended claims.

What is claimed is:

1. A shearing foil for a dry-shaving head provided with a multiplicity of generally polygonal hair-inlet spacings for cooperation with a movable blade to shear hairs extending through said openings, the openings each having a plurality of major long inwardly convex cutting edges defining the vertices of the polygon and of circular arc-segmental configuration whereby corresponding main cutting edges of an array of said

openings around a central opening lie along a relatively large diameter circle centered on said central openings, and respective inwardly convex minor short cutting edges truncating each vertex and lying along a relatively small diameter circle centered between a plurality of nearest-neighbor openings, whereby corresponding minor edges of said nearest-neighbor openings lie along said small diameter circle.

2. The shearing foil defined in claim 1 wherein said polygon is a hexagon.

3. The shearing foil defined in claim 1 wherein said polygon is a square.

4. The shearing foil defined in claim 1 wherein the openings are generally octagonal.