

[54] **DRY SHAVER**

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[22] Filed: **Nov. 11, 1974**

[21] Appl. No.: **522,348**

[52] U.S. Cl. **30/43; 30/42; 30/346.51**

[51] Int. Cl. **B26b 19/00**

[58] Field of Search **30/42, 43, 43.3, 346.51**

[56] **References Cited**

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Primary Examiner—Al Lawrence Smith

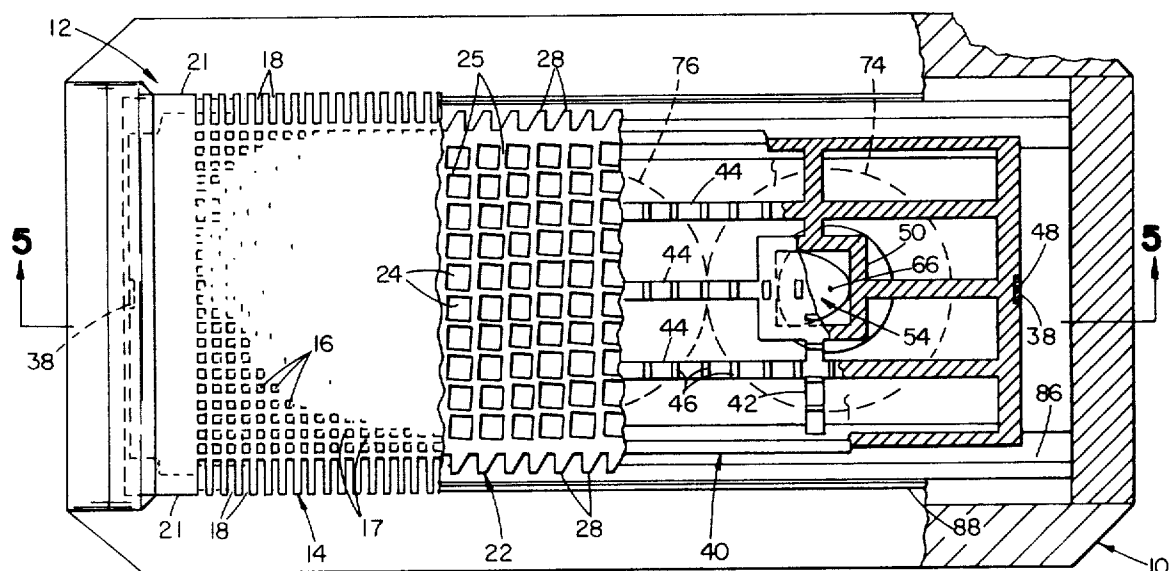
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ABSTRACT

A dry shaver comprises a screen member having a multiplicity of apertures of polygonal configuration, and a cutter member having a multiplicity of apertures of the same polygon configuration as the screen apertures. A drive is connected to the cutter member for driving the cutter member along a closed path of the same polygon configuration as the screen and cutter apertures so that all points on the cutter member move along paths of the same size and produce a plurality of shearing actions between the cutting edges of each cutter aperture and cooperating cutting edges of apertures of screen member in each closed path cycle of the drive.

17 Claims, 12 Drawing Figures



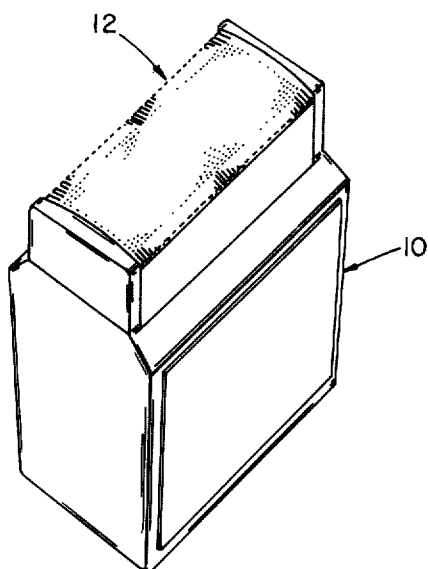


FIG 1

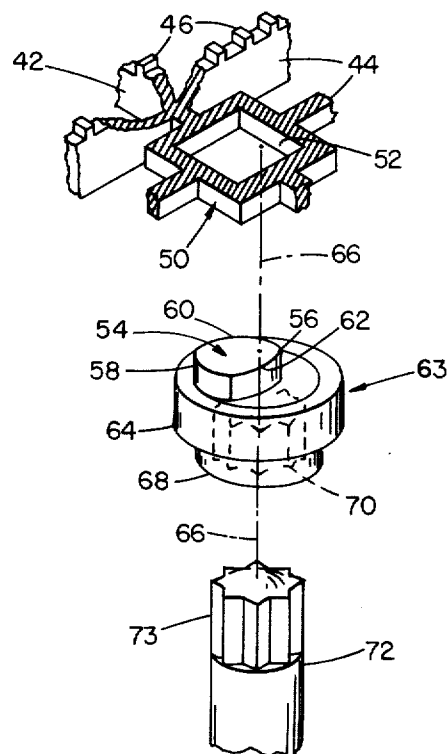


FIG 3

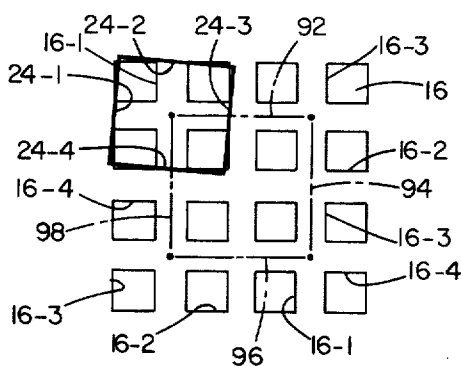


FIG 11

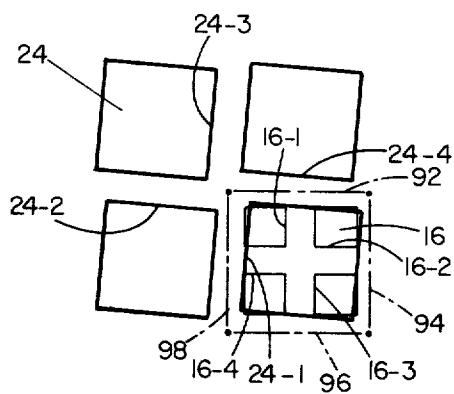
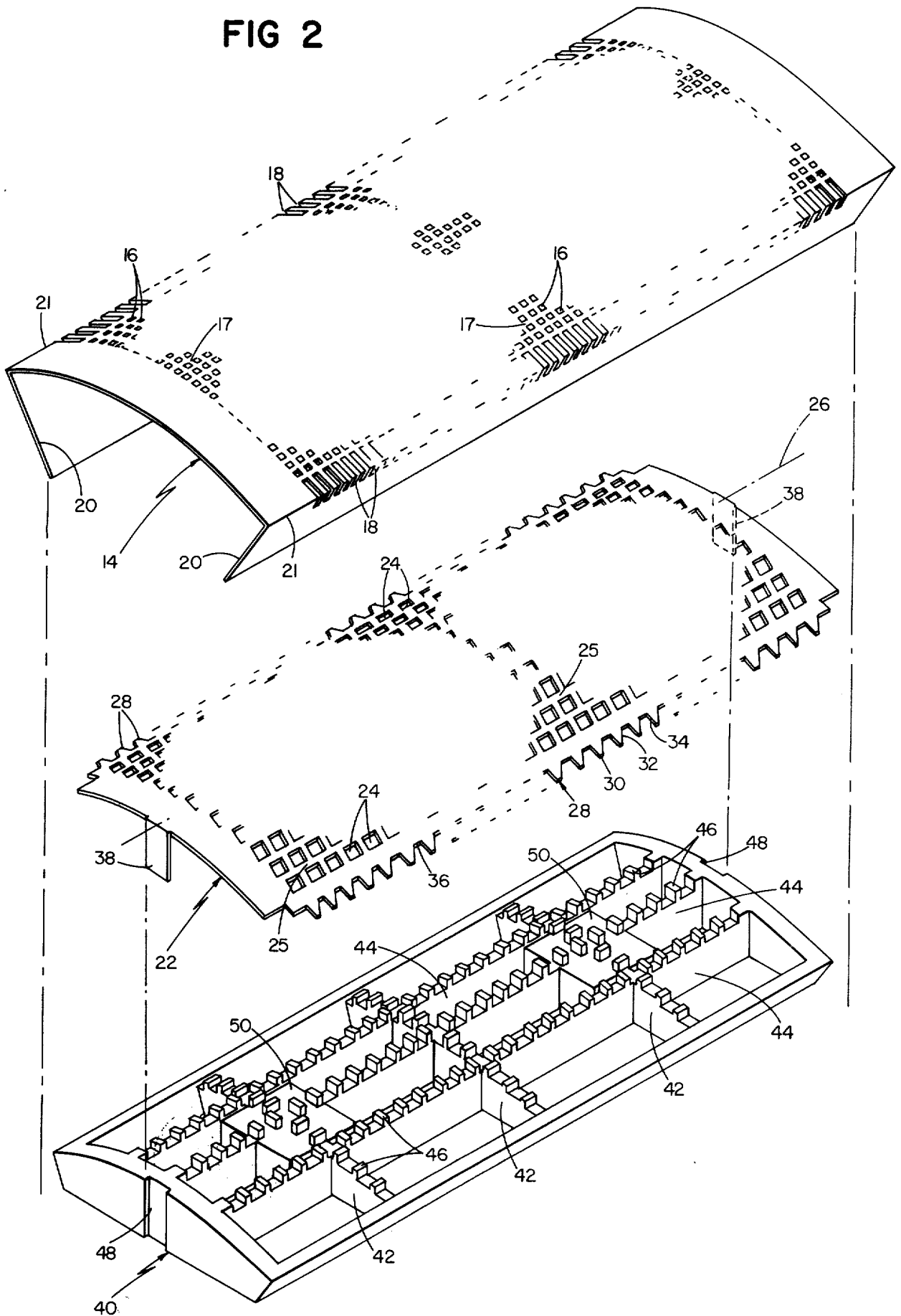
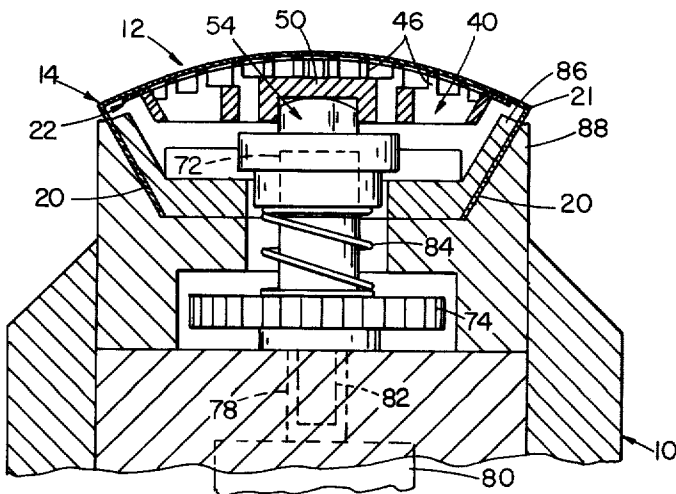
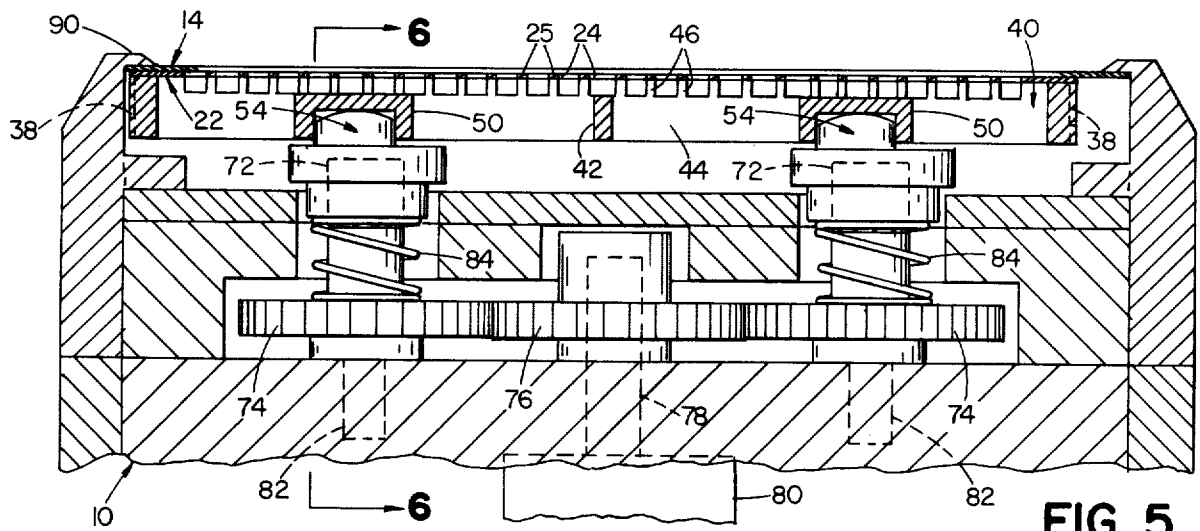
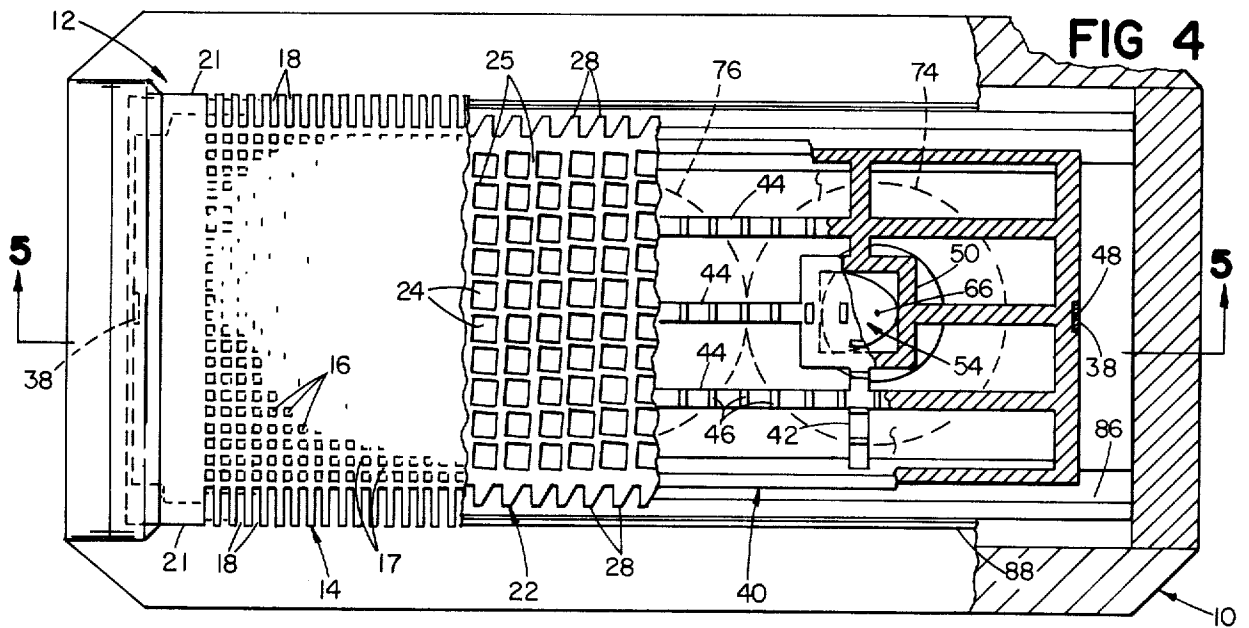
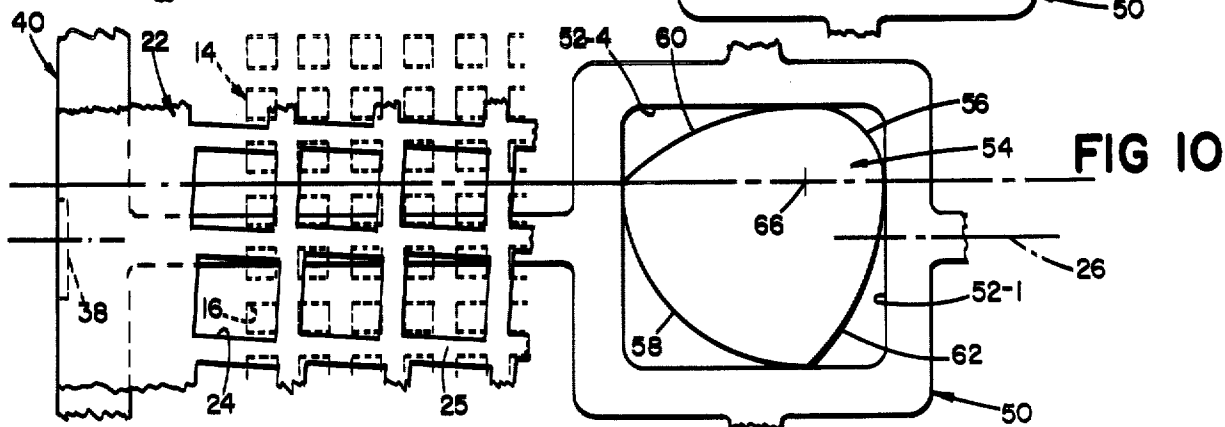
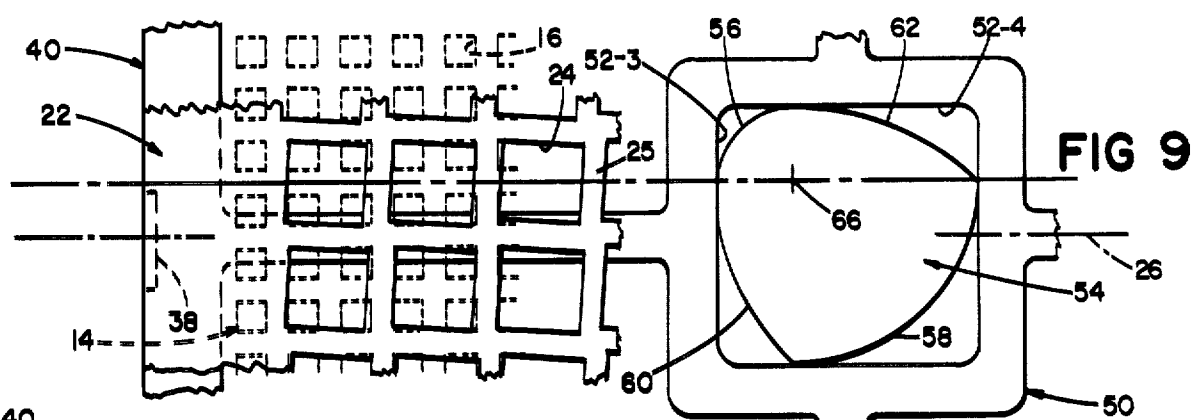
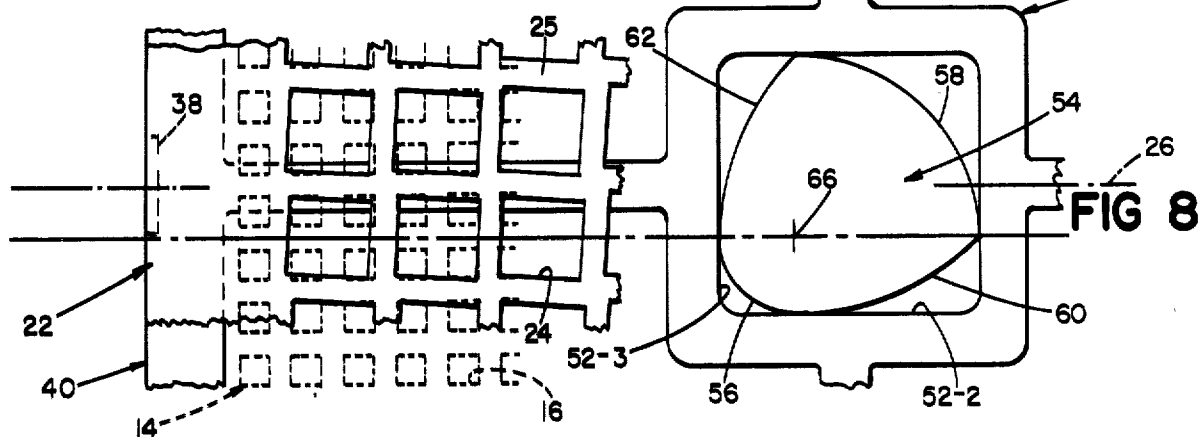
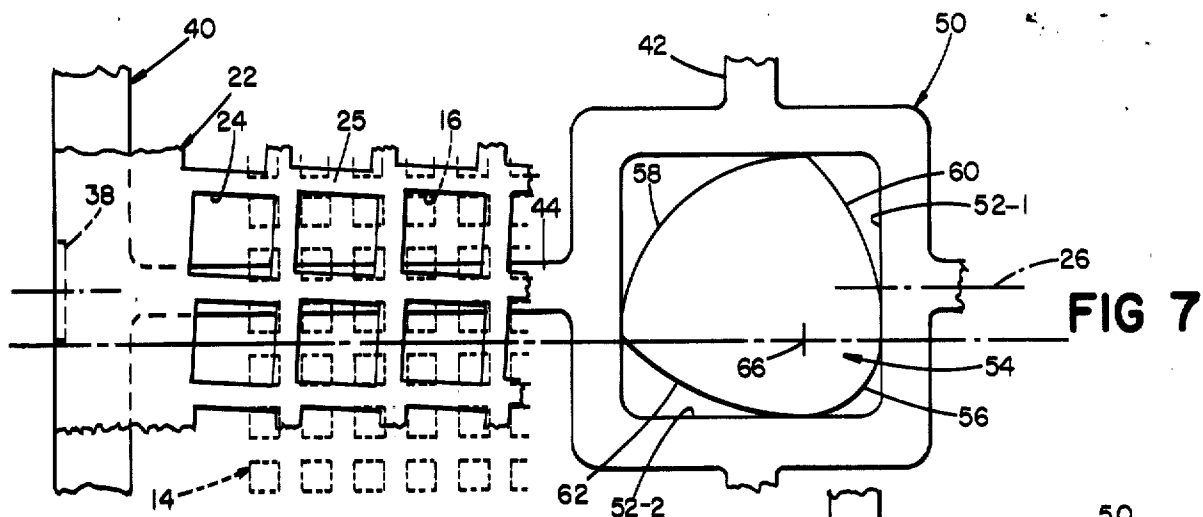


FIG 12

FIG 2







DRY SHAVER

SUMMARY OF INVENTION

This invention relates to improvements in mechanical razors which are usually, but not necessarily, electrically powered; and more specifically to a novel shaving head configuration for such razors.

In typical dry shavers of the type to which the invention relates, an apertured outer screen member cooperates with an inner cutter member which is driven relative to the outer screen member to cut hair elements that are introduced through the apertured outer member. It has been proposed, in electrically powered dry shavers, to impart oscillatory, reciprocating or rotary motion to the cutter element. There have been numerous proposals of shaving head configurations, directed to efforts to improve shaving factors such as the length of time required for shaving, the closeness and smoothness of the shave obtained, and the minimization of skin irritation. It is a principal object of this invention to provide an improved dry shaver arrangement which provides increased functional use of cutting edges of components of the shaving head.

In accordance with the invention there is provided a dry shaver that has an outer screen member with multiple apertures of polygonal configuration, a cooperating cutter member that has a surface that mates with the inner surface of the screen member and also has multiple apertures of the same polygonal configuration as the screen member; and a drive for moving the cutter member along a polygonal path which is also of the same configuration as the configurations of the apertures in the screen member and in the cutter member. Each drive cycle is composed of a series of drive strokes and different sets of screen and cutter aperture edges successively coact over the series of drive strokes in each drive cycle. Thus a beard hair introduced through a screen aperture is cut from several different directions during each cutter drive cycle.

While various polygonal configurations may be employed, in preferred embodiments, the apertures and the drive path are all of square configuration. In preferred embodiments, also, coacting cutting edges of the apertures of the screen member and the cutter member are angularly offset with respect to each other at a small but effective angle, preferably about 5°. The length of each drive stroke of the cutter member along each edge of the polygonal drive path preferably is at least twice the spacing of corresponding sides of two adjacent screen apertures and preferably is also at least the spacing of corresponding sides of two adjacent cutter apertures but is less than twice that spacing. In each stroke of the drive cycle, each cutter aperture performs a plurality of cutting actions with cooperating edges of screen apertures and over the entire cycle all of the edges of the screen apertures and of the cutter apertures are used in succession. The invention thus enables rapid and efficient cutting of beard or other body hair.

Other objects, features and advantages of the invention will be seen as the following description of a particular embodiment progresses, in conjunction with the drawings, in which:

FIG. 1 is a perspective view of a dry shaver incorporating the present invention;

FIG. 2 is an exploded view of components of the shaving head of the dry shaver shown in FIG. 1;

FIG. 3 is an exploded fragmentary view of drive elements in the embodiment shown in FIG. 1;

FIG. 4 is a top plan view of the dry shaver shown in FIG. 1 with parts broken away;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 5;

FIGS. 7—10 are a series of diagrams indicating the coordination between the drive and the cutter member and the screen member or shear plate;

FIG. 11 is a diagram showing the path followed by one aperture in the cutter relative to the apertures of the screen member; and

FIG. 12 is a diagram showing the interaction of a group of cutter apertures with a group of screen apertures.

DESCRIPTION OF PARTICULAR EMBODIMENT

With reference to FIG. 1, the shaver comprises a body 10 containing suitable drive such as an electric motor (not shown). A head 12 attached to the body houses a cutter member which is driven by the motor. Additional details of components of the head may be seen with reference to FIG. 2.

The head structure includes a shear plate or cutter screen 14 of stainless steel 0.002 inch thick and which has a multiplicity of square apertures 16 arranged in a compact rectangular matrix. In this embodiment each aperture 16 is about 0.019 inch on a side and defined by webs 17 of about 0.015 inch width, the apertures being spaced about 0.034 inch on centers. The screen includes a matrix of 1144 apertures 16. In addition, elongated apertures 18 are formed along either side of the matrix of apertures 16. Each aperture 18 has a width of 0.019 inch and a length of 0.122 inch. The side portions of screen 14 are bent downwardly and inwardly to form flanges 20, each bend line 21 passing through apertures 18.

A second component of the shaver is a cutter member 22 in the form of 0.015 inch thick stainless steel plate and that has a multiplicity of square apertures 24 arranged in a rectangular matrix. Each aperture is about 0.053 inch on a side and separated by webs 25 of about 0.015 inch width, the apertures being spaced about 0.068 inch apart on centers and the apertures are set at an angle relative to the transverse axis 26 of cutter plate 22, in this embodiment that angle being about 5°. Formed along either edge of the plate 22 are a series of teeth 28, each of which has a tip width of about 0.019 inch and a length of about 0.04 inch, with an inclined edge 32 and a transverse edge 34; and is spaced from the adjacent tooth by a root 36 that is also about 0.019 inch in width. Two hundred fifty apertures 24 are formed in plate 22 and twenty-five teeth 28 are formed along either side. At either end of cutter plate 22 is a tab 38.

Cutter plate 22 is mounted on a support 40 molded of a plastic material such as Delrin that has transverse ribs 42 that are curved at a radius of one inch and longitudinal connecting ribs 44 that extend the length of the cutter support. Formed on the ribs are spaced upstanding support posts 46 which receive nonapertured portions of plate 22 at intersections of webs 25. Slots 48 are provided in each end of support 40 for receiving cutter plate tabs 38 to secure plate 22 to support 40.

Formed in the cutter support are two cam receiving structures 50, additional details of which may be seen in FIGS. 3-6. Each structure 50 defines an inner cam surface 52 of square configuration, 0.17 inch on a side. Mounted for driving engagement in each cam aperture 52 is a cam 54. Each cam is also molded of Delrin and includes curved surface 56 of 0.0495 inch radius, curved surface 58 of 0.1195 inch radius and two curved transition surfaces 60, 62 each of 0.169 inch radius as best indicated in FIGS. 7-10. The drive member 63 on which cam 54 is formed has an intermediate enlarged cylindrical portion 64 concentric with axis 66 and a base portion 68 in which is formed a spline socket 70 as indicated in FIG. 3.

Also as indicated in FIG. 3, a stub shaft 72 has a spline portion 73 which is received in socket 70 for driving the cam element 54. Shaft 72 (as shown in FIGS. 5 and 6) is integral with a pinion gear 74 and each pinion gear is in engagement with a driving gear 76, the shaft 78 of which is connected to the electric drive motor 80 as indicated in FIGS. 5 and 6. As indicated in FIGS. 4 and 5, motor shaft 78 drives gear 76 which in turn drives pinion gears 74. Each pinion gear 74 has a stub shaft 82 that is journaled in the shaver body 10. Springs 84 urge each drive member 63 upwardly so that the cam surfaces 56-62 are disposed in engagement with surfaces 58 of cam socket 50 of cutter support 40. Cutter plate 22 is secured to cutter support 40. Cutter screen 14 is positioned over the assembly of cutter plate 22 and support 40, side flanges 20 are secured between members 86 and 88 as indicated in FIG. 6 and end caps 90 overlie the ends of screen 14 as indicated in FIG. 5.

As indicated in FIG. 4 edge teeth 28 are disposed adjacent elongated screen edge slots 18 for cutting coaction, while skewed square apertures 24 of the cutter plate 22 are disposed for cutting coaction with screen apertures 16.

In operation, motor 80 drives the two cams 54 in rotation about axes 66 and the cam surfaces, in engagement with surfaces 52 of the cam socket, produce movement of cutter support 40 and cutter plate 22 along a drive path of square configuration composed of four strokes, each about 0.07 inch in length. FIGS. 7-10 are a series of diagrams indicating the movement of the cutter plate 22 relative to the cutter screen 14. With cam 54 being driven in a clockwise direction from the position shown in FIG. 7, cutter apertures 24 are driven to the right along a straight drive stroke line a distance of about 0.07 inch to the position shown in FIG. 8 by the engagement of cam surface 62 with cam socket surface 52-1. This movement drives the left edge 24-1 of each cutter aperture 24 to the right past four screen apertures 16, producing four distinct cutting actions each using the entire edge 16-1 of a screen aperture. As the cam 54 continues to rotate, surface 62 in engagement with socket surface 52-2 drives the cutter in a vertically downward drive stroke from the position indicated in FIG. 8 to the position shown in FIG. 9, moving the upper edge 24-2 of each cutter aperture 24 downwardly in shearing relation past edges 16-2 of four screen apertures 16 to provide four more individual cutting actions. Further rotation of the cam 54 from the position shown in FIG. 9 to FIG. 10 moves cutter apertures 24 to the left along a horizontal drive stroke path so that each right vertical cutter aperture edge 24-3 cooperates with edges 16-3 of four screen aper-

tures 16 in four more distinct shearing actions. In completion of the cycle, the cam 54 moves from the position shown in FIG. 10 to the position shown in FIG. 7 in which the lower horizontal edges 24-4 of apertures 24 cooperate in shearing relation with upper edges 16-4 of four apertures 16 in the screen. The stroke portions 92, 94, 96, 98 of the square path of the drive cycle, along which a single cutter aperture 24 is driven relative to the group of sixteen screen apertures with which it cooperates in cutting action in each cycle of cam 54 is illustrated diagrammatically in FIG. 11; and the four cutter apertures 24 which coact in each drive cycle in cutting action with a group of four screen apertures 16 are indicated in FIG. 12. Thus, as cutter 22 is driven from left to right along stroke path 92, each cutter edge 24-1 coacts in cutting action with four screen edges 16-1 (each such cutting action occurring between two straight edges that are offset from one another at a 5° angle); as cutter 22 is driven downwardly along stroke path 94, each cutter edge 24-2 coacts in cutting action with four screen edges 16-2; as cutter 22 is driven from right to left along stroke path 96, each cutter edge 24-3 coacts in cutting action with four screen edges 16-3; and as cutter 22 is driven upwardly (as viewed in FIGS. 7-12) along stroke path 98, each cutter edge 24-4 coacts in cutting action with four screen edges 16-4.

In each of the four distinct stroke drive directions in each cycle of the cam drive, an edge of a cutter aperture 24 cooperates with four edges of screen apertures 16 to provide four distinct shearing actions; and in each drive cycle each aperture 16 in screen 14 similarly cooperates with four different cutter apertures 24 in performing cutting action on beard hairs disposed in that aperture. As is apparent from FIGS. 11 and 12, the length of each stroke 90, 92, 94, 96 of the cutter 22 is greater than the length of the side of a cutter aperture 24 by about the width of a web 25 as well as being greater than the distance between opposite edges of two adjacent screen apertures 16 by about the width of a web 17. While the pattern of apertures in the screen and cutter may take a variety of regular polygon forms, the square form illustrated is preferred. The angular relation of the straight cutting edges in the cutter plate 22 and the screen 14, together with the straight line cutter drive, provides efficient shearing of hairs presented through the screen apertures particularly when a multiplicity of hairs are so presented. Although it is preferred that the surface of the screen 14 be convex, it will be apparent that other configurations might be employed in appropriate circumstances. The convex contour of cutter 22 provides screen support along almost the entire under surface of screen 14. Although it is not necessary to provide slots 18 in the shoulders of the screen, they and the cooperating cutter teeth 28 are preferably provided to facilitate the cutting of long hairs presented through the screen 14 at the edge thereof. The resilient mounting of the cutter assembly allows contact between the cutter and the screen to be maintained while providing compensation for wear and other minor variations.

While a particular embodiment of the invention has been shown and described, it will be understood that various modifications will be apparent to those skilled in the art and therefore it is not intended that the invention be limited to the disclosed embodiments of to details thereof, and departures may be made therefrom

within the spirit and scope of the invention as defined in the claims.

What is claimed is:

1. A dry shaver comprising:

a shear plate having a multiplicity of apertures therein, each said shear plate aperture being of polygonal configuration and defining a series of cutting edges thereabout;

cutter structure against one side of said shear plate, said cutter structure having a multiplicity of apertures therein, each said cutter aperture being of the same polygonal configuration as said shear plate apertures and defining a series of cutting edges thereabout for shearing coaction with said cutting edges in said shear plate; and

drive means connected to said cutter structure for driving said cutter structure relative to said shear plate for shearing coaction between cooperating cutting edges of apertures of said shear plate and said cutter structure;

said drive means has means for driving said cutter structure along a path of the same polygonal configuration as that of said apertures in said shear plate and said cutter structure.

2. The shaver as claimed in claim 1 wherein said polygonal configuration is quadrilateral.

3. The shaver as claimed in claim 2 wherein said quadrilateral configuration is square.

4. The shaver as claimed in claim 1 wherein said apertures in said cutter structure are larger than said apertures in said shear plate.

5. The shaver as claimed in claim 1 wherein said drive means is adapted to move said cutter structure in a plurality of strokes in a cycle of said polygonal movement thereof, the length of each said stroke being substantially greater than the distance from one side of one shear plate aperture to the corresponding side of the next adjacent shear plate aperture.

6. The shaver as claimed in claim 5 wherein said cutter structure apertures have sides of about the same length as each said stroke.

7. The shaver as claimed in claim 1 wherein said edges of said apertures in said shear plate and said cutter structure which cooperate in shearing action on movement of said cutter structure are angularly offset with respect to each other at a small but effective angle for effective shearing action.

8. The shaver as claimed in claim 7 wherein said angle is about 5°.

9. The shaver as claimed in claim 8 wherein said apertures in said cutter structure are larger than said apertures in said shear plate.

10. The shaver as claimed in claim 9 wherein said po-

lygonal configuration is square.

11. The shaver as claimed in claim 7 wherein said drive means is adapted to move said cutter structure in a plurality of strokes in said polygonal movement thereof, each said stroke having a length substantially twice the distance from one side of one shear plate aperture to the corresponding side of the next adjacent shear plate aperture.

12. The shaver as claimed in claim 11 wherein the spacing between corresponding sides of said cutter structure apertures is substantially the same as the length of each said stroke.

13. The shaver as claimed in claim 12 wherein said polygonal configuration is square.

14. A dry shaver comprising:

a screen member having a multiplicity of apertures of polygonal configuration, each edge of each said screen aperture defining a cutting edge,

a cutter member having a multiplicity of apertures of the same polygon configuration as said screen apertures, each edge of each said cutter aperture defining a cutting edge,

biasing structure urging said cutting member and said screen member into engagement with one another, and a drive connected to said cutter member for driving said cutter member along a closed path of the same polygon configuration as said screen and cutter apertures so that all points on said cutter member move along paths of the same size and produce a plurality of shearing actions between the cutting edges of each said cutter aperture and cooperating cutting edges of apertures of said screen member in each closed path cycle of said drive.

15. The shaver is claimed in claim 14 wherein said screen and cutter apertures are of square configuration, said screen apertures are arranged in a rectangular matrix, said cutter apertures are arranged in a rectangular matrix and said cutter apertures are angularly offset relative to said screen apertures so that each cutter aperture cutting edge produces a progressive shearing action as it is moved past a cooperating screen aperture cutting edge by said cutter drive.

16. The shaver as claimed in claim 15 wherein said cutter drive moves said cutter member in four distinct drive strokes in each drive cycle, one stroke along each edge of the square drive path, the length of each said drive stroke being about the same as the spacing between corresponding edges of said cutter apertures.

17. The shaver as claimed in claim 16 wherein the spacing between corresponding edges of said cutter apertures is at least twice the space between corresponding edges of said screen apertures.

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