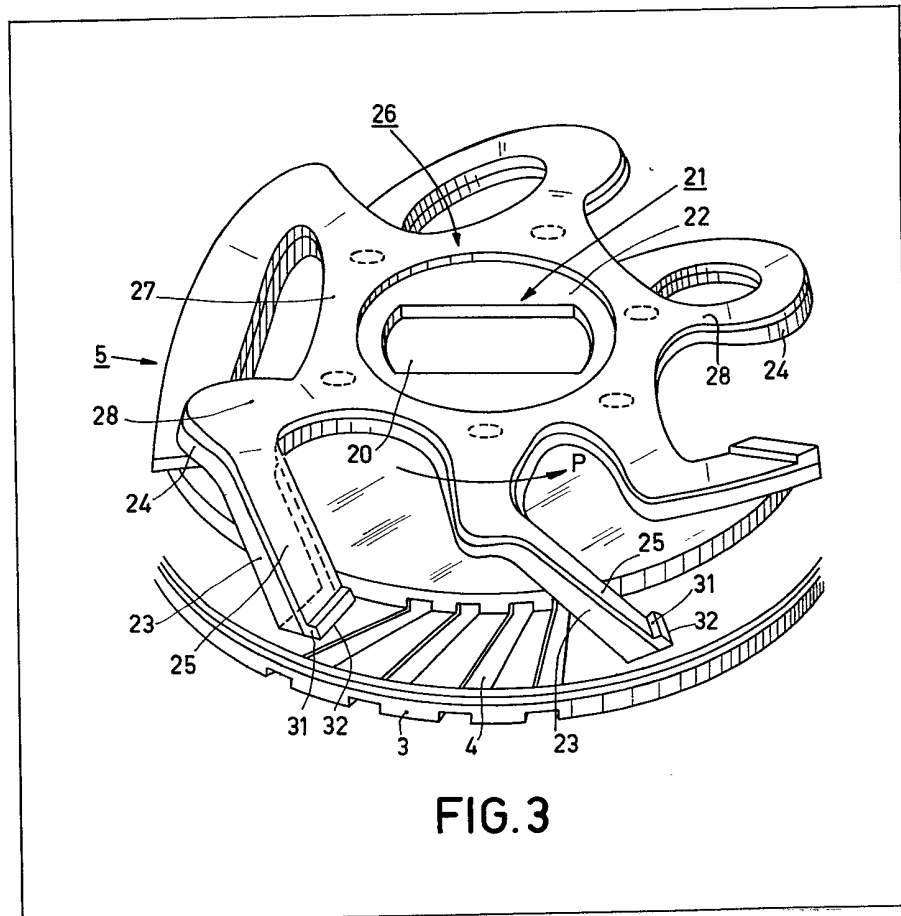


- (21) Application No 7941772
- (22) Date of filing 4 Dec 1979
- (30) Priority data
- (31) 7811930
- (32) 7 Dec 1978
- (33) Netherlands (NL)
- (43) Application published 2 Jul 1980
- (51) INT CL³
B26B 19/04 // 19/42
- (52) Domestic classification
B4B 41 42 48
- (56) Documents cited
None
- (58) Field of search
B4B
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(54) Cutting unit for a dry-shaving apparatus

(57) The movable cutting unit of a dry-shaver comprises a plurality of cutters 23 and a corresponding plurality of hair-pulling blades 25 each arranged in front of one of the cutters for movement therewith relative to the shear plate or foil of the shaver, and each slidable on the cutter so as to be movable relative thereto for its hair-pulling action. In order to increase the distance through which the hairs are pulled up from the skin by blades of a given thickness, the edge 32 of each hair-pulling blade which contacts the hairs is formed on a locally forwardly projection portion 31 of the blade.



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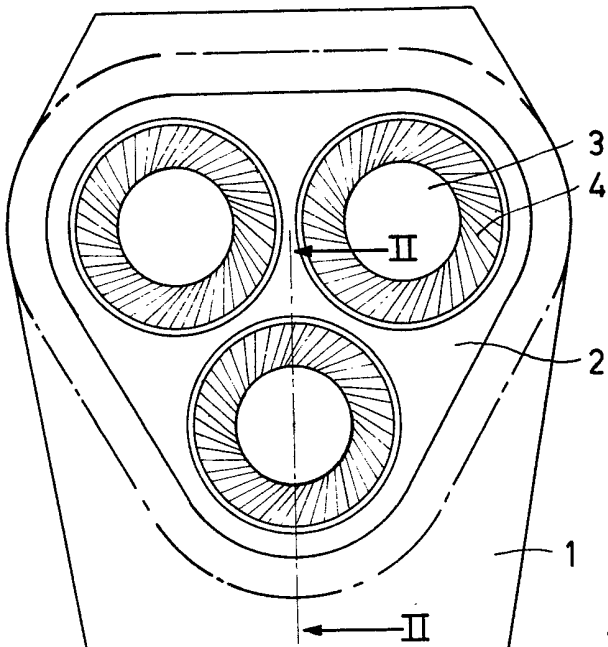


FIG. 1

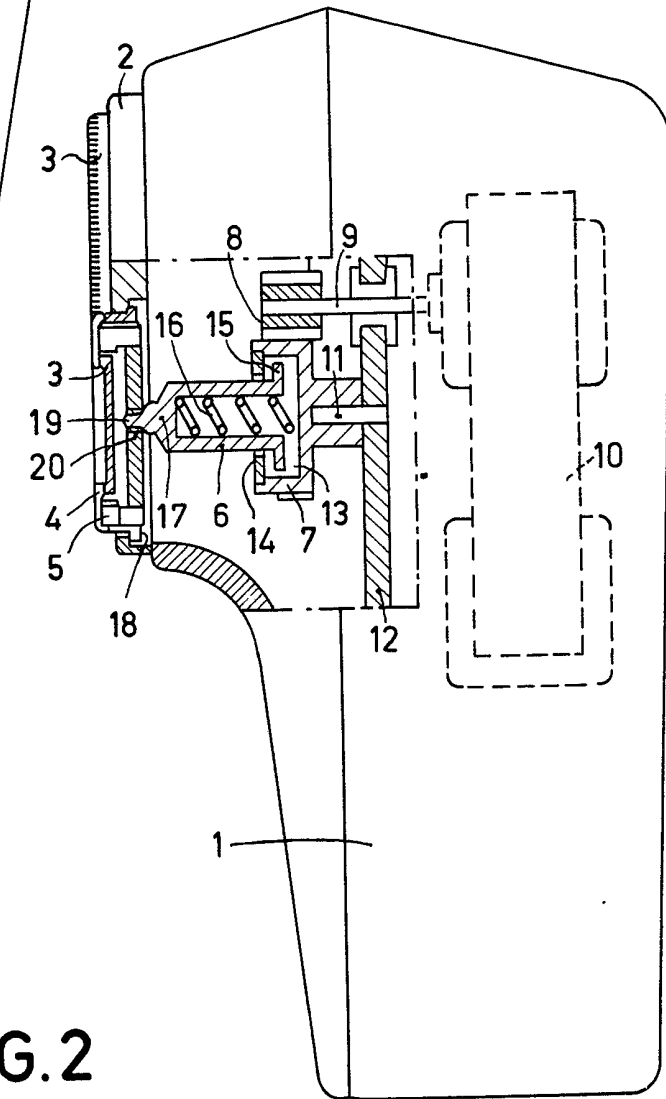


FIG. 2

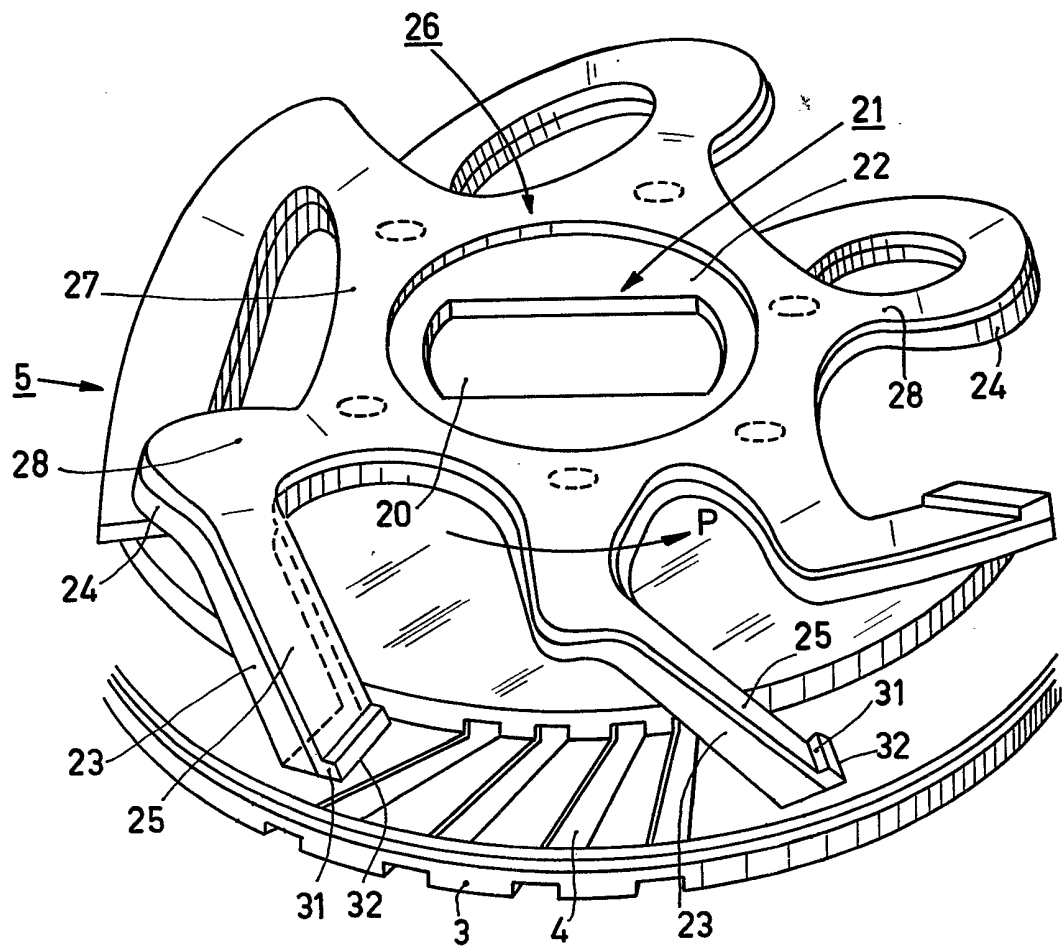


FIG. 3

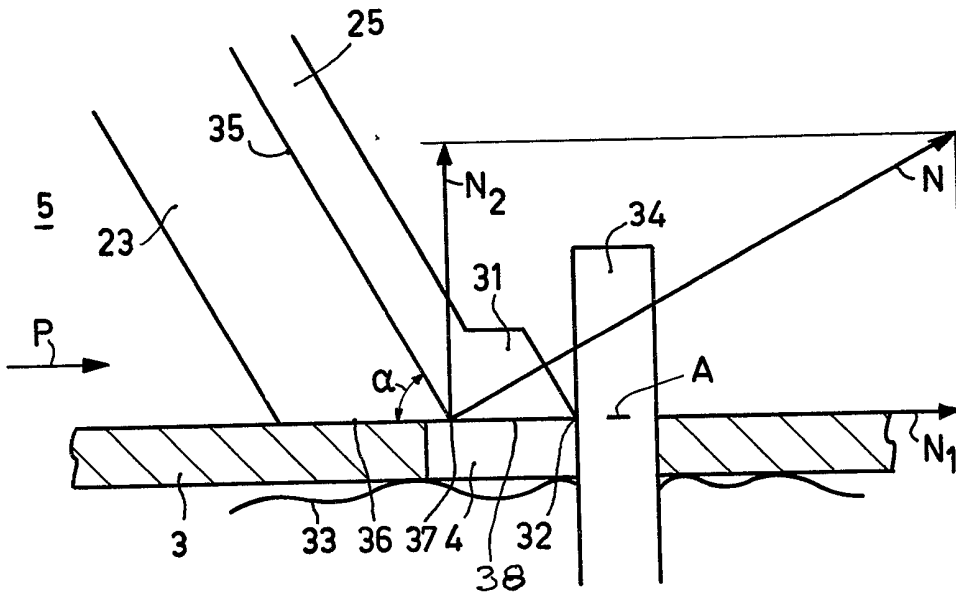


FIG. 4

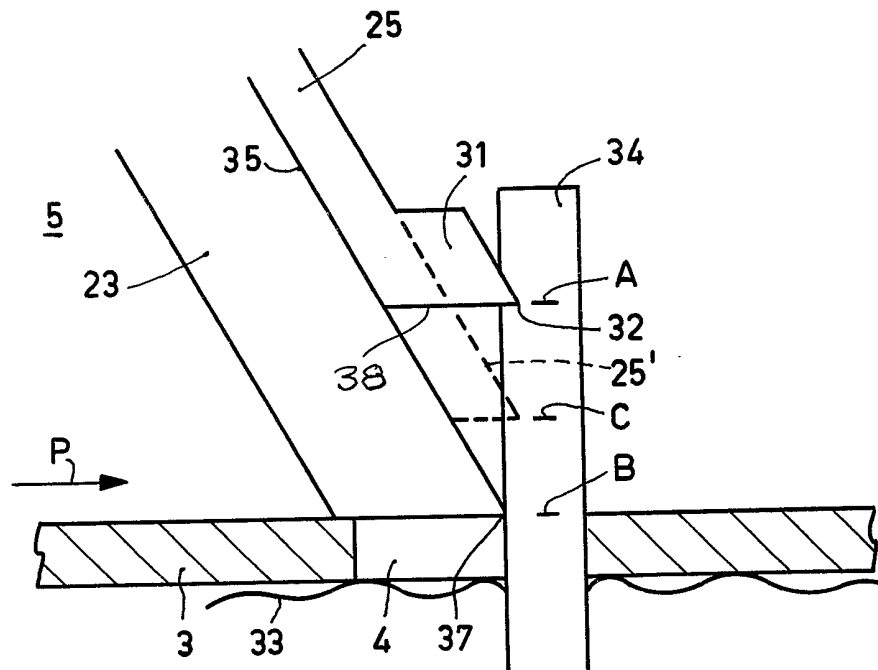


FIG. 5

SPECIFICATION

Cutting unit for a dry-shaving apparatus

5 The invention relates to a cutting unit for a dry-shaving apparatus of the kind (hereinafter referred to as "the kind described") having a shear plate with hair-entry apertures and a cutting unit which is moveable relative to and cooperates with the shear plate. The invention relates particularly to a cutting unit comprising a plurality of cutters and a plurality of hair-pulling elements each disposed in front of an associated one of the cutters with respect to the direction of the cutting movement thereof and each arranged for movement with the associated cutter relative to the shear plate and for movement relative to the cutter in directions away from and towards the shear plate when the cutting unit is in operation in a shaving apparatus, each hair pulling element having an edge which, as the element moves over a hair-entry aperture of the shear plate in front of the associated cutter when the cutting unit is in operation, contacts hairs protruding through that aperture and, by movement of the hair-pulling element away from the shear plate under the reaction force from said hairs, pulls these hairs further through the aperture.

The term "shear plate" is to be understood herein to include a shear foil.

30 Such a cutting unit is known from the Applicant's prior United Kingdom Patent Specification No. 1,467,557. In such cutting units the hair-pulling elements serve to pull up the hairs slightly from the skin before they are cut off by the associated cutters, which enables a closer shave to be obtained. The distance through which the hairs can be pulled up is limited by the properties of the hairs and the skin and in particular by the shape and dimensions of the hair-pulling elements.

40 According to the invention there is provided a cutting unit for a dry-shaving apparatus of the kind described, comprising a plurality of cutters and a plurality of hair-pulling elements each disposed in front of an associated one of the cutters with respect to the direction of the cutting movement thereof and each arranged for movement with the associated cutter relative to the shear plate and for movement relative to the cutter in directions away from and towards the shear plate when the cutting unit is in operation in a shaving apparatus, each hair-pulling element having an edge which, as the element moves over a hair-entry aperture of the shear plate in front of the associated cutter when the cutting unit is in operation, contacts hairs protruding through that aperture and, by movement of the hair-pulling element away from the shear plate under the reaction force from said hairs, pulls these hairs further through the aperture, wherein said edge of each hair-pulling element is formed on a locally projecting portion of the element which projects forwardly from the element with respect to the direction of the cutting movement of the associated cutter.

In a preferred embodiment of the invention each hair-pulling element has sliding contact with a

70 surface of the associated cutter for the movement of the hair-pulling element relative to the cutter, and each hair-pulling element has the form of a blade which is locally thickened to form said projecting portion on which the contact edge of the element is formed.

The invention further provides a dry-shaving apparatus of the kind described having a cutting unit according to the invention.

75 An embodiment of the invention will now be described with reference to the accompanying drawings, in which

Figure 1 is a front elevation of a dry-shaving apparatus of the kind described having three cutting units and associated shear plates,

80 *Figure 2* is a side elevation of the shaving apparatus of *Figure 1* showing a shear plate and cutting unit and an associated driving means in cross-section, the section being taken on the line II-II in *Figure 1*,

85 *Figure 3* is a perspective view, drawn to an enlarged scale, of an embodiment of the cutting unit according to the invention for the shaving apparatus shown in *Figures 1* and *2*, part of the associated shear plate also being shown, and

90 *Figures 4* and *5* are diagrammatic side views, drawn to an even larger scale, of a cutter and associated hair-pulling element of the cutting unit shown in *Figure 3*, and a portion of the associated shear plate, illustrating the operation of the hair-pulling element.

The shaving apparatus shown in *Figures 1* and *2* comprises a housing 1 on which is mounted a shear plate holder 2 for three shear plates 3. The shear plates 3 are of circular form and each have a circular pattern of hair-entry apertures 4 in the form of slots.

100 A rotary cutting unit 5 (*Figure 2*) is situated on the inner side of each shear plate 3 for cooperation therewith. One of the cutting units is shown schematically in *Figure 2* and in perspective and on an enlarged scale in *Figure 3*.

105 The cutting units 5 are rotated relative to the shear plates by an electric motor 10 to which each cutting unit is coupled by an associated hollow spindle 6 (*Figure 2*) and gear wheel 7 and a gear wheel 8 fixed on the shaft 9 of the electric motor 10. Each gear wheel 7 is rotatably journaled on an associated spindle 11 which is fixed in a mounting plate 12. The gear wheel 7 is formed with a cavity 13, which is closed by a cover plate 14. This cavity accommodates a flange 15 formed on the end of the hollow spindle 6. The flange 15 has a non-circular, for example, square, shape and the cavity 13 is shaped accordingly so that a coupling is obtained for transmitting the rotary movement of the gear wheel 7 to the spindle 6 whilst at the same time allowing the spindle to tilt in all directions. A coil spring 16, which for the greater part is disposed in the hollow spindle 6 and which is compressed between an end wall of the hollow spindle 6 and an end wall of the cavity 13 in the gear wheel 7, exerts a force on the spindle 6 in the direction of the cutting unit 5. A conical portion 17 of the spindle 6 bears against the cutting unit 5 to transmit this force to the cutting unit and *via* the cutting unit to the shear plate 3, so that a

flange 18 around the periphery of the shear plate is urged against the shear plate holder 2. During use of the shaving apparatus, the shear plates 3, together with the associated cutting units 5 and spindles 6, can be pressed inwards against the action of the spring 16 under the pressure with which the shear plates are held against the user's skin.

A coupling for transmitting the rotary movement of each spindle 6 to the associated cutting unit 5 is formed by an end portion 19 of the spindle of a substantially rectangular cross-section engaging in a central coupling aperture 20 of corresponding shape in the cutting unit 5.

All three cutting units of the shaving apparatus of Figures 1 and 2 are coupled to the motor 10 in the above manner, the three gear wheels 7 meshing with the one centrally disposed gear wheel 8 on the motor shaft 9.

As shown in Figure 3, each cutting unit 5 comprises a cutting member 21 of sheet material having a central body 22 which at its periphery is formed with cutters 23, which are connected to the central body 22 by arms 24. The central body 22 is formed with the coupling aperture 20. As shown in Figures 4 and 5, each cutter 23 has at its front (with respect to the direction of movement P of the cutter) a sloping surface 35 which forms an acute angle α with a surface 36 of the cutter which is in sliding contact with the inner side of the respective shear plate 3. The surface 36 is formed at the distal end of the cutter, which has an elongate shape. The edge 37 at which the surfaces 35 and 36 meet is the cutting edge of the cutter. In the operation of the shaving apparatus the sliding surface 36 of each cutter 23 travels over the hair-entry slots 4 in the respective shear plate and the cutting edge 37 of the cutter, in cooperation with the shear plate at the boundaries of the slots, severs the hairs which protrude through the slots.

Each cutting unit 5 also comprises a hair-pulling member 26 which is made from resilient sheet material and comprises a substantially annular central portion 27, around the periphery of which is formed a plurality of hair-pulling elements in the form of blades 25. These hair-pulling blades 25, which are equal in number and spacing to the cutters 23, are connected to the central portion 27 by arms 28.

The cutting member 21 and the hair-pulling member 26 are assembled to form a cutting unit 5 by securing the central portion 27 of the hair-pulling member to the central body 22 of the cutting member, for example, by spot-welding, in relative positions such that each hair-pulling blade 25 is in sliding contact with the front surface 35 of an associated one of the cutters 23. Owing to the resilience of the connecting arms 28, the hair-pulling blades 25 are movable relative to the cutters 23 in directions away from and towards the respective shear plate 3, the resilience of the arms urging the blades towards the shear plate. The hair-pulling blades travel round with the cutters relative to the shear plate in the operation of the shaving apparatus. The hair-pulling blades have an elongate shape corresponding to that of the cutters, and at its distal

end each hair-pulling blade has a surface 38 which is in sliding contact with the inner side of the shear plate in front of the sliding surface 35 of the associated cutter. Each hair-pulling blade 25 is formed at its distal end with a portion 31 which projects forwardly from the blade with respect to the direction of movement of the blade over the shear plate. In the embodiment shown this forwardly projecting portion is formed by giving the blade a locally thicker portion at its distal end. The sliding surface 38 of the blade extends across the projecting portion 31 and meets the front surface of this portion of the blade at an edge 32 which is the leading edge of the blade in the movement of the blade over the shear plate, the two surfaces forming an acute angle at this edge.

Figures 4 and 5 illustrate the operation of a hair-pulling blade and the associated cutter, a portion of the user's skin being shown at 33, with a hair 34 protruding from it. When the hair 34 is caught in a hair-entry aperture 4, the rotary movement of the cutting unit 5 in the direction of the arrow P relative to the shear plate 3 will bring the leading edge 32 of the hair-pulling blade 25 into contact with the hair at location A thereon, as shown in Figure 4. The contact edge 32 has a sharpness such that it will slightly penetrate the hair 34 without severing it. A reaction force is exerted on the hair-pulling blade 25 by the hair 34 in a direction opposite to the direction of movement P of the blade. This force will be counteracted by the component N_1 of the normal force N which is exerted on the hair-pulling blades 25 by the front surface 35 of the associated cutter 23. For the sake of simplicity the slight frictional forces between cutter 23 and hair-pulling blade 25 have been ignored. The component N_2 of the normal force N will cause the hair-pulling blade 25 to slide along the surface 35 of the cutter 23, away from the shear plate 3. The angle α between the surface 35 and the surface 36 of the cutter 23 which engages with the shear plate 3 must be smaller than 90° .

As a result of, *inter alia*, the natural elasticity of the user's skin, the hair 34 will be pulled up from the skin by the hair-pulling blade 25 until the cutting edge 37 of the cutter 23 has reached the hair at location B thereon (Figure 5). Thus, the hair 34 is pulled from the skin 3 through a distance from A to B before being severed by the cutter 23 in cooperation with the shear plate 3.

Without the hair-pulling blade 25 the hair 34 would have been severed at the location A. Thus, the length of the stubble left in the skin is shorter when a shaving apparatus having a cutting unit with hair-pulling blades is used than when an apparatus without such blades is used.

By forming the contact edge 32 of each hair-pulling blade, i.e., the edge which contacts the hairs, on a forwardly projecting portion of the blade in accordance with the invention, the distance between this edge of the blade and the cutting edge 37 of the associated cutter 23 is increased compared with a hair-pulling blade which does not have a projecting portion and which has a thickness throughout equal to that of the major portion of the blade 25. With such a blade, which is represented by the broken

lines 25' in Figure 5, the hair 34 is contacted by the contact edge of the blade at a location C on the hair and is pulled up from the skin through a distance BC before being cut off by the cutter 23. Thus, the length of hair cut off using the hair-pulling blade 25 with the projecting portion 31 is greater by an amount equal to the distance AC.

By increasing the thickness of the blade 25 only locally to obtain the desired increase in the distance between the contact edge 32 of the blade and the cutting edge 37 of the associated cutter, as opposed to increasing the thickness over the whole area of the blade, a significant increase in the mass of the blade is avoided and also, when, as in the embodiment shown, the hair-pulling blades form parts of a hair-pulling member which is made from resilient sheet material, the resilience of the connecting arms 28 is not impaired.

The invention is not limited to a cutting unit of the rotary type; it can also be applied to a reciprocatory cutting unit, for example.

CLAIMS

1. A cutting unit for a dry-shaving apparatus of the kind described, comprising a plurality of cutters and a plurality of hair-pulling elements each disposed in front of an associated one of the cutters with respect to the direction of the cutting movement thereof and each arranged for movement with the associated cutter relative to the shear plate and for movement relative to the cutter in directions away from and towards the shear plate when the cutting unit is in operation in a shaving apparatus, each hair-pulling aperture element having an edge which, as the element moves over a hair-entry aperture of the shear plate in front of the associated cutter when the cutting unit is in operation, contacts hairs protruding through that aperture and, by movement of the hair-pulling element away from the shear plate under the reaction force from said hairs, pulls these hairs further through the aperture, wherein said edge of each hair-pulling element is formed on a locally projecting portion of the element which projects forwardly from the element with respect to the direction of the cutting movement of the associated cutter.

2. A cutting unit as claimed in Claim 1, wherein each hair-pulling element has sliding contact with a surface of the associated cutter for the movement of the hair-pulling element relative to the cutter, and wherein each hair-pulling element has the form of a blade which is locally thickened to form said projecting portion on which the contact edge of the element is formed.

3. A cutting unit substantially as herein described with reference to Figures 3, 4 and 5 of the accompanying drawings.

4. A dry-shaving apparatus of the kind described having a cutting unit as claimed in Claim 1, 2 or 3.