

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 rotatable relative to the shear plate. The invention
10 relates particularly to a cutting unit comprising a cutting member which comprises a central body and a plurality of hair-cutting blades distributed around said body, the cutting unit further comprising a plurality of hair-pulling blades each of which
15 is arranged in front of an associated one of the hair-cutting blades with respect to the direction of movement thereof and is carried by an arm which is secured to the central body of the cutting member and which is movable to permit movement of
20 the hair-pulling blade relative to the associated hair-cutting blade in directions away from and towards the shear plate when the cutting unit is mounted in a dry-shaving apparatus.

A shaving apparatus having a cutting unit of this construction is for example described in our prior Patent Specification No. 1,467,557. In this known cutting unit the arms carrying the hair-pulling blades are secured to the central body of the cutting member by an adhesive or by spot-welding.

30 According to the present invention there is provided a cutting unit for a dry-shaving apparatus of the kind described, comprising a cutting member which comprises a central body and a plurality of hair-cutting blades distributed around said body, the cutting unit further comprising a plurality of
35 hair pulling blades each of which is arranged in front of an associated one of the hair-cutting blades with respect to the direction of movement thereof and is carried by an arm which is secured to the central body of the cutting member and which is
40 movable to permit movement of the hair-pulling blade relative to the associated hair-cutting blade in directions away from and towards the shear plate when the cutting unit is mounted in a dry-shaving apparatus, wherein said arms are secured
45 to the central body of the cutting member by a coupling piece which constitutes a separate component from the cutting member and said arms.

In a preferred embodiment of the cutting unit
50 according to the invention, the coupling piece comprises a plurality of spokes which extend radially with respect to a central axis of the coupling piece or tangentially of a circle concentric with this axis, which axis coincides with the rotational axis of the
55 cutting unit, and each of said arms is clamped to the central body of the cutting member by an associated one of said spokes to secure the arm to said central body.

Each of the spokes may extend over an associated one of said arms and constitute a stop therefor to limit the movement of the hair-pulling blade carried by that arm.

The spokes may extend beyond said arms so that the cutting unit, comprising the cutting member,
65 the hair-pulling blades and the coupling piece can

be held by the distal ends of the spokes during assembly or dismantling. The spokes may be interconnected by a ring which is arranged concentrically with the central axis of the coupling piece.

70 The coupling piece may have a coupling aperture to receive a member for transmitting drive to the cutting unit.

The coupling piece may be provided with resilient connecting elements each of which extends through an opening in the central body of the cutting member and constitutes a snap connection to secure the coupling member to the coupling piece.

In addition to the hair-pulling blades, other components, such as, for example, a separate mass-inertia body, may be secured to the cutting member by the coupling piece.

In one embodiment of the invention, the hair-pulling blades form parts of a hair-pulling member having a lamelliform central portion to which the
85 blades are connected by said arms and which has a central opening which receives a central portion of the coupling piece, and the central portion of the hair-pulling member is formed with a resilient projection at the periphery of its central opening,
90 which projection presses against the central portion of the coupling piece.

The invention also provides a coupling piece for the above preferred embodiment of the cutting unit according to the invention, the coupling piece comprising a plurality of spokes which extend radially with respect to a central axis of the coupling-piece or tangentially of a circle concentric with this axis, the spokes being constructed for clamping the arms which carry the hair-pulling blades of the cutting unit to the central body of the cutting member of the unit.

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

105 Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which

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

Fig. 2 is a side elevation of the shaving apparatus of *Fig. 1* showing one of the shear plates and cutting units and an associated driving means in cross-section taken on the line II-II in *Fig. 1*,

Fig. 3 is an exploded perspective view of an embodiment of a cutting unit according to the invention for the apparatus shown in *Figs. 1* and *2*,

Fig. 4 is a plan view of the cutting unit of *Fig. 3* in the assembled condition,

Fig. 5 is a sectional view taken on the line V-V in *Fig. 4*,

Fig. 6 is a view similar to *Fig. 4* showing a modification of the coupling piece,

Figures 7 and 8 are diagrammatic side views, drawn to a greatly enlarged scale, of a hair-cutting blade and associated hair-pulling blade and a portion of the associated shear plate illustrating the operation of the hair-pulling blade, and

Fig. 9 is a plan view of a modification of the hair-pulling member of the cutting unit shown in *Figs. 3*,

4 and 5.

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

A rotary cutting unit (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 but is shown in detail and on an enlarged scale in Figures 3 to 5.

The cutting units 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 (Fig. 2) and gear wheel 7 and a gear wheel 8 fixed on the shaft 9 of the motor 10. The gear wheels 7 are each rotatably journaled on an associated spindle 11 which is fixed in a mounting plate 12. The gear wheel 7 has a cavity 13 which is closed by a cover plate 14. This cavity accommodates a flange 15 formed at 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 the transmission of the rotary movement of the gear wheel 7 to the spindle 6. A coil spring 16, which for the greater part is situated 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 pressed 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 springs 16, under the pressure with which the shear plates are held against the user's skin.

A coupling for the transmission of the rotary movement of each spindle 6 to the associated cutting unit 5 is formed by an end portion 19 of the spindle 6 of 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 apparatus shown in 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 Figures 3, 4 and 5, each cutting unit 5 comprises a cutting member 21 having hair-cutting blades 29, a hair-pulling member 22 having hair-pulling blades 23, a coupling piece 24 and a mass-inertia body 25.

The mass-inertia body consists of an annular disc 25 having a central opening 26 and three equispaced recesses 27 in its inner periphery.

The cutting member 21 comprises an annular, plate-shaped central body 28, around the outer periphery of which the hair-cutting blades 29 are evenly distributed. Like the mass-inertia body 25, the central body 28 of the cutting member has a

central opening 30 and three equispaced recesses 31 in its inner periphery.

The hair-pulling member 22 is made from resilient sheet material and comprises a substantially annular lamelliform central portion 32, around the outer periphery of which the hair-pulling blades 23 are evenly distributed. The blades 23, which are equal in number and spacing to the hair-cutting blades 29, are integrally connected to the central portion 32 by arms 33. The central portion 32 also has a central opening 34 and three equispaced recesses 35 in its inner periphery.

The coupling piece 24 comprises a hollow cylindrical central portion 36 having a wall 37 and flange 38 at one end. In the wall 37 the coupling aperture 20 is formed for the coupling of the cutting unit 5 to the hollow spindle 6. From the flange 38 spokes 39 extend in a direction which may be radial or, as in the embodiment shown, tangential to a common circle concentric with the cylindrical portion 36 of the coupling piece. The spokes 39, which are equal in number to the hair-cutting blades 29 and the hair-pulling blades 23, are each formed on one side with an axially extending projection 40. In the cylindrical wall of the central portion 36 of the coupling piece 24, at each of three angularly spaced places, two axially extending slits 41 are formed to leave between them an axially extending wall portion 42 which is resilient in directions towards and away from the centre of the coupling piece 24. Each wall portion 42 is formed on its outer side with a shoulder 43 having a sloping face on one side. On the outer side of the rigid portions of the wall are formed three axially extending ribs 44 which are equally spaced from one another circumferentially of the wall.

The central openings 26, 30 and 34 of the mass-inertia body 25, the cutting member 21 and the hair-pulling member 22 all have the same diameter, which diameter corresponds to the outer diameter of the cylindrical wall of the central portion 36 of the coupling piece 24 so that this central portion 36 will be received in the openings 26, 30 and 34 with a snug fit. In the assembly of the cutting unit, the hair-pulling member 22, the cutting member 21 and the mass-inertia body 25 are arranged in succession on the central portion 36 of the coupling piece 24 in the sequence shown in Fig. 3, with the axially extending ribs 44 of the coupling piece engaging in the recesses 27, 31 and 35 of the mass-inertia body 25, cutting member 21 and hair-pulling member 22. As the cylindrical portion 36 of the coupling piece 24 is passed through the central openings 26, 30 34 of the components 25, 21, 22 the resilient wall portions 42 of the coupling piece are first deflected inwardly by cooperation between the inner edges of the components 25, 21, 22 and the sloping faces of the shoulders 43 of the wall portions 42, and subsequently resile outwardly so that the shoulders 43 engage with a snap action over the inner edge of the mass-inertia body 25 to secure the components 25, 21, 22 firmly to the coupling piece 24. The components 25, 21, 22 can be released from the coupling piece simply by pressing the wall portions 42 inwardly to disengage the

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shoulders 43 from the inner edge of the mass-inertia body 25. The engagement of the ribs 44 of the coupling piece with the recesses 27, 31, 35 of the components 25, 21, 22 prevents rotation of these components relative to one another and to the coupling piece.

As shown in Figures 7 and 8, each hair-cutting blade 29 has at its front (with respect to the direction of movement of the blade) a sloping surface 48 which forms an acute angle α with a surface 53 of the blade which is in sliding contact with the inner side of the respective shear plate 3. The edge 51 at which the surfaces 48 and 53 meet is the cutting edge of the hair-cutting blade and the angle α is the cutting angle.

The hair-pulling blades 23 are each slidably arranged on the front surface 48 of an associated one of the hair-cutting blades 29 so as to be movable away from and towards the shear plate 3. At its proximal end, the connecting arm 33 of each hair-pulling blade is held between the projection 40 on one of the spokes 39 of the coupling piece 24 and the central body 28 of the cutting member 21. The coupling piece 24 is so constructed and proportioned that in the assembled condition of the cutting unit 5 the spokes 39 are slightly elastically deflected in the axial direction so that the proximal ends of the connecting arms 33 are clamped between the projections 40 and the central body 28. The resilience of the free portion of each connecting arm 33 permits the movement of the respective hair-pulling blade 23 relative to the associated hair-cutting blade 29 away from and towards the shear plate.

As shown in Figure 4, the distal end 45 of each spoke 39 extends over a connecting arm 33 which is adjacent the connecting arm which is clamped in position by the projection 40 of the same spoke 39. The end 45 of this spoke constitutes a stop for said adjacent connecting arm and thus limits the movement of the hair-pulling blade 23 carried by that arm. Obviously, it is also possible to design the spokes so that one spoke serve both for clamping and as stop for the same connecting arm.

The elastic properties of each connecting arm 33 are dependent on, *inter alia*, the place on the arm at which the projection 40 of the relevant spoke 39 engages the arm. The elastic properties of each connecting arm can be determined simply yet accurately by the shape and the dimensions of the coupling piece 24. The coupling piece is preferably manufactured from a plastics material.

In the modification shown in Fig. 6, the spokes 46 of the coupling piece 24 extend beyond the connecting arms 33 of the hair-pulling member 22. During assembly or dismantling the cutting unit can then be held by the distal ends of the spokes so that the risk of damage to the other parts of the cutting unit is reduced. The spokes are interconnected by ring 47 to increase their strength and rigidity in the plane containing the spokes, which ring is formed integrally with the spokes. The spaces left between the spokes ensure that the removal of hair cuttings from the vicinity of the cutting unit is impeded to the least possible extent.

Figures 7 and 8 illustrate the operation of a hair-pulling blade. When a hair 49 is caught in a hair-entry aperture 4, the leading edge 50 of the hair-pulling blade 23, moving in the direction of arrow P, will contact the hair at location A on the hair. The edge 50 has a sharpness such that it will slightly penetrate the hair 49 at A without severing it. A reaction force is exerted on the hair-pulling blade 23 by the hair 49 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 blade 29 (Fig. 7). For the sake of simplicity the slight frictional forces between the two blades have been neglected. The component N_2 of the normal force N will cause the hair-pulling blade 23 to slide along the surface 48 of the hair-cutting blade 29, away from the shear plate 3.

Owing to, *inter alia*, the natural elasticity of the user's skin, the hair 49 will be pulled up from the skin by the hair-pulling blade 23 until the cutting edge 51 of the hair-cutting blade 20 has reached the hair at location B thereon (Fig. 8). The hair is then severed by the cutting blade 29 in cooperation with the shear plate 3. Thus, a part of the hair 49 is cut off which is longer than the part which would be cut off without the aid of the hair-pulling blade by an amount equal to the distance between A and B, so that a closer shave is obtained.

As is evident from Fig. 8, the point 52 of the connecting arm 33 of the hair-pulling blade 23 has not yet reached the distal end 45 of the relevant spoke 39 when the blade 23 is in the active position shown in Figure 8. However, owing to inertial forces there is a risk of the hair-pulling blade 23 moving further away from the shear plate 3, in which case the spoke end 45 functions as a stop to limit the movement of the connecting arm 33 and thus of the hair-pulling blade.

In the above embodiments the hair-pulling blades 23 form integral parts of a hair-pulling member 23. However, the coupling piece 24 may also be employed for securing separate independent hair-pulling blades to the cutting member 21.

If the hair-pulling blades form parts of a hair-pulling member having a central plate-shaped body, the clamping portion of the spokes of the coupling piece 24 may alternatively engage this central plate-shaped body.

The coupling piece may be fixed to the cutting member 21 by means other than a snap connection, for example, by welding, screws or an adhesive.

Generally, the use of hair-pulling blades will impose limits on the speed of rotation of the cutting unit. Since in cutting the hairs the amount of kinetic energy of the cutting unit is an important factor, the operation of the apparatus may be improved in some cases by increasing its mass, for example, by means of the separate additional mass-inertia body 25. However the coupling piece can alternatively be made so heavy that an additional mass-inertia body is not necessary.

In the modification shown in Fig. 9 the hair-pulling member 22 is formed in each of the recess-

ses 35 with a resilient finger 54 which projects radially inwards from the annular central portion 32 of the hair-pulling member. The depth of the recesses 35 and the length of the fingers 54 are such that when the hair-pulling member 22 is assembled on the coupling piece 24, the fingers 54 are deflected from the plane of the central portion 32 of the hair-pulling member by the axially extending ribs 44 of the coupling piece and slide along these ribs. In the assembled position the fingers 54 press under their own resilience against the ribs 44 so that the hair-pulling member 22 and the coupling piece 24 are thus safely secured together in a simple manner.

At each of the recesses 35 a positioning lug 55 is bent out of the plane of the central portion 32 of the hair-pulling member. The position of one of the lugs 55 prior to bending is shown in broken lines in Fig. 9. When the cutting member 21 is arranged on the hair-pulling member 22 in the assembly of the cutting unit, the lugs 55 engage in the recesses 31 in the central body 28 of the cutting member to define exactly the position of the cutting member in relation to the hair-pulling member about the rotational axis of the cutting unit.

CLAIMS

1. A cutting unit for a dry-shaving apparatus of the kind described, comprising a cutting member which comprises a central body and a plurality of hair-cutting blades distributed around said body, the cutting unit further comprising a plurality of hair-pulling blades each of which is arranged in front of an associated one of the hair-cutting blades with respect to the direction of movement thereof and is carried by an arm which is secured to the central body of the cutting member and which is movable to permit movement of the hair-pulling blade relative to the associated hair-cutting blade in directions away from and towards the shear plate when the cutting unit is mounted in a dry-shaving apparatus, wherein said arms are secured to the central body of the cutting member by a coupling piece which constitutes a separate component from the cutting member and said arms.

2. A cutting unit as claimed in Claim 1, wherein the coupling piece comprises a plurality of spokes which extend radially with respect to a central axis of the coupling piece or tangentially of a circle concentric with this axis, which axis coincides with the rotational axis of the cutting unit, and wherein each of said arms is clamped to the central body of the cutting member by an associated one of said spokes to secure the arm to said central body.

3. A cutting unit as claimed in Claim 2, wherein each of the spokes extends over an associated one of said arms and constitutes a stop therefor to limit the movement of the hair-pulling blade carried by that arm.

4. A cutting unit as claimed in Claim 3, wherein the spokes extend beyond said arms.

5. A cutting unit as claimed in Claim 2, 3, 4 wherein the spokes are interconnected by a ring which is arranged concentrically with the central axis of the coupling piece.

6. A cutting unit as claimed in any of the preceding claims, wherein the coupling piece has a

coupling aperture to receive a member for transmitting drive to the cutting unit.

7. A cutting unit as claimed in any of the preceding claims, wherein the coupling piece is provided with resilient connecting elements each of which extends through an opening in the central body of the cutting member and constitutes a snap connection to secure the cutting member to the coupling piece.

8. A cutting unit as claimed in any of the preceding claims, wherein a separate mass-inertia body is secured to the cutting member by the coupling piece.

9. A cutting unit as claimed in any of the preceding claims, wherein the hair-pulling blades form parts of a hair-pulling member having a lemniscate central portion to which the blades are connected by said arms and which has a central opening which receives a central portion of the coupling piece, and wherein the central portion of the hair-pulling member is formed with a resilient projection at the periphery of its central opening, which projection presses against the central portion of the coupling piece.

10. A cutting unit substantially as herein described with reference to Figures 3, 4, 5, 7 and 8 or Figures, 3, 4, 5, 7 and 8 when modified by Figure 6 or 9.

11. A coupling piece for a cutting unit as claimed in Claim 2, comprising a plurality of spokes which extend radially with respect to a central axis of the coupling piece or tangentially of a circle concentric with this axis, the spokes being constructed for clamping the arms which carry the hair-pulling blades of the cutting unit to the central body of the cutting member of the unit.

12. A dry-shaving apparatus of the kind described having a cutting unit as claimed in any of Claims 1 to 10.



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ses 35 with a resilient finger 54 which projects radially inwards from the annular central portion 32 of the hair-pulling member. The depth of the recesses 35 and the length of the fingers 54 are such that when the hair-pulling member 22 is assembled on the coupling piece 24, the fingers 54 are deflected from the plane of the central portion 32 of the hair-pulling member by the axially extending ribs 44 of the coupling piece and slide along these ribs. In the assembled position the fingers 54 press under their own resilience against the ribs 44 so that the hair-pulling member 22 and the coupling piece 24 are thus safely secured together in a simple manner.

At each of the recesses 35 a positioning lug 55 is bent out of the plane of the central portion 32 of the hair-pulling member. The position of one of the lugs 55 prior to bending is shown in broken lines in Fig. 9. When the cutting member 21 is arranged on the hair-pulling member 22 in the assembly of the cutting unit, the lugs 55 engage in the recesses 31 in the central body 28 of the cutting member to define exactly the position of the cutting member in relation to the hair-pulling member about the rotational axis of the cutting unit.

CLAIMS

1. A cutting unit for a dry-shaving apparatus of the kind described, comprising a cutting member which comprises a central body and a plurality of hair-cutting blades distributed around said body, the cutting unit further comprising a plurality of hair-pulling blades each of which is arranged in front of an associated one of the hair-cutting blades with respect to the direction of movement thereof and is carried by an arm which is secured to the central body of the cutting member and which is movable to permit movement of the hair-pulling blade relative to the associated hair-cutting blade in directions away from and towards the shear plate when the cutting unit is mounted in a dry-shaving apparatus, wherein said arms are secured to the central body of the cutting member by a coupling piece which constitutes a separate component from the cutting member and said arms.

2. A cutting unit as claimed in Claim 1, wherein the coupling piece comprises a plurality of spokes which extend radially with respect to a central axis of the coupling piece or tangentially of a circle concentric with this axis, which axis coincides with the rotational axis of the cutting unit, and wherein each of said arms is clamped to the central body of the cutting member by an associated one of said spokes to secure the arm to said central body.

3. A cutting unit as claimed in Claim 2, wherein each of the spokes extends over an associated one of said arms and constitutes a stop therefor to limit the movement of the hair-pulling blade carried by that arm.

4. A cutting unit as claimed in Claim 3, wherein the spokes extend beyond said arms.

5. A cutting unit as claimed in Claim 2, 3, 4 wherein the spokes are interconnected by a ring which is arranged concentrically with the central axis of the coupling piece.

6. A cutting unit as claimed in any of the preceding claims, wherein the coupling piece has a

coupling aperture to receive a member for transmitting drive to the cutting unit.

7. A cutting unit as claimed in any of the preceding claims, wherein the coupling piece is provided with resilient connecting elements each of which extends through an opening in the central body of the cutting member and constitutes a snap connection to secure the cutting member to the coupling piece.

8. A cutting unit as claimed in any of the preceding claims, wherein a separate mass-inertia body is secured to the cutting member by the coupling piece.

9. A cutting unit as claimed in any of the preceding claims, wherein the hair-pulling blades form parts of a hair-pulling member having a lemelli-form central portion to which the blades are connected by said arms and which has a central opening which receives a central portion of the coupling piece, and wherein the central portion of the hair-pulling member is formed with a resilient projection at the periphery of its central opening, which projection presses against the central portion of the coupling piece.

10. A cutting unit substantially as herein described with reference to Figures 3, 4, 5, 7 and 8 or Figures, 3, 4, 5, 7 and 8 when modified by Figure 6 or 9.

11. A coupling piece for a cutting unit as claimed in Claim 2, comprising a plurality of spokes which extend radially with respect to a central axis of the coupling piece or tangentially of a circle concentric with this axis, the spokes being constructed for clamping the arms which carry the hair-pulling blades of the cutting unit to the central body of the cutting member of the unit.

12. A dry-shaving apparatus of the kind described having a cutting unit as claimed in any of Claims 1 to 10.