

This invention relates to a dry shaving apparatus with a housing, a drive mechanism and a shaving head including at least one arcuate short hair cutter assembly and at least one long hair cutter assembly associated therewith, in accordance with the features identified in the preamble of patent claims 1, 2, 12 and 13.

From DE-2,309,342 C2 a dry shaving apparatus of this type is known which has a shaving head rigidly mounted on the housing and accommodating different hair cutters including one short hair cutter and two long hair cutters in parallel arrangement with the short hair cutter. The use of the short hair cutter simultaneously with one of the long hair cutters provided requires the operator of such a shaving apparatus to exercise great care with regard to the engagement and guiding of the two hair cutting arrangements with and over the skin surface and the different skin contours in the cheek, chin and neck areas. Such a relatively complicated and exacting shave making a shaving apparatus difficult to handle cannot be expected from the operator.

From EP 00 77 093 A2 a dry shaving apparatus is known having at least one screen shearing portion and comb shearing portion secured in the shaving head frame as well as a lower cutter assembly coupled to the drive mechanism. In order to accomplish a simultaneous operation of the screen shearing portion and the comb shearing portion, the operative part of the comb shearing portion is connected with the operative part of the screen shearing portion in laterally protruding fashion, with an obtuse angle being formed in the connection area of the two shearing portions between the plane determined by the operative part of the comb shearing portion and the tangential plane applied to the operative part of the screen shearing portion. To ensure simultaneous use of screen shearing portion and comb shearing portion, it is, however, necessary that the shaving apparatus be always guided at a specific angle over the respective contour of the skin surface to prevent disengagement of one the two shearing portions from the skin. Guiding the shaving apparatus over the contours of the skin with such precise accuracy makes the shaving apparatus substantially more difficult to manipulate, resulting as a rule in an unsatisfactory shave because experience has shown that the operator is generally not inclined to pay the necessary attention during the entire length of the shaving operation.

From US-A-3,279,056 a shaving apparatus is known having two hair cutters of different configurations comprising a short hair cutter and a long hair trimmer used independently of one another. In this arrangement, the short hair cutter and the long hair trimmer are provided in relative parallel arrangement on the lateral flanges of a cutter head carrier which is mounted between two resilient bracket arms projecting from the shaver case and is pivotally carried by means of bearing trunnions engaged with the bracket arms, with the resilience of the bracket arms being selected such as to hold the cutter head carrier in any desired swivel position, in particular in either of the two extreme positions predetermined by stop means in which a respective one of the hair cutters provided is expected to produce optimum cutting results. In this known shaver, simultaneous and continuous use of both hair cutters during a shave is not possible since the swivel bearing of the cutter head carrier is arranged a long distance below the engagement surfaces of the two hair cutters with the skin surface.

It is an object of the present invention to provide a shaving apparatus equipped with different hair cutters in which it is ensured that, with the shaver housing held against the skin surface at customary angles, at least one hair cutter automatically engages the skin surface in combination with at least one other, differently configured hair cutter, that, with varying directions of sliding motion of the shaving head over the skin surface, the hair cutters of different configurations are in engagement with the skin surface to a large extent, and that in at least one of the directions of sliding motion at least two of the hair cutters of different configurations are in use simultaneously.

According to the invention, these requirements are satisfied in a shaving apparatus of the type initially referred to by the features identified in patent claims 1, 2, 12 and 13.

Advantageous modifications of the embodiments set out are indicated in the related subclaims. It is a particular advantage of the embodiments set out that, within the customary angles at which the shaving head of the shaving apparatus is held against the skin surface, both cutter assemblies of different configurations are automatically moved into engagement with the skin surface and remain engaged therewith during the length of the shave, regardless of the forces bearing thereon and the varying directions of sliding motion of the shaving head over the skin surface, and further that in at least one

of the directions of sliding motion at least two of the hair cutter assemblies of different configurations are in use simultaneously in the sense of performing a shearing operation.

Further advantages and details of the invention will become apparent from the subsequent description and the drawings showing some preferred embodiments. In the drawings,

FIG. 1 is a perspective view of a shaving apparatus having a pivoted shaving head including different cutter assemblies;

FIG. 2 is a longitudinal sectional view of a shaving head of FIG. 1 pivotally mounted on the housing of the shaving apparatus;

FIG. 3 is a schematic view of a shaving head having a short hair cutter assembly and an inclined long hair cutter assembly;

FIG. 4 is a schematic view of a shaving head having a short hair cutter assembly and a single-edge long hair cutter assembly;

FIG. 5 is a schematic view of a shaving head having a long hair cutter assembly arranged in a vertically off-set relationship to the short hair cutter assembly;

FIG. 6 is a schematic view of a shaving head having a short hair cutter assembly arranged intermediate two long hair cutter assemblies; and

FIG. 7 is a cross-sectional view of the shaving head of FIGS. 1 and 2.

Referring now to FIG. 1 of the drawings, there is shown a shaving apparatus with a housing 1 accommodating an electric drive mechanism which is adapted to be activated and deactivated by a switch 3, and with a shaving head 2 which is pivotally mounted about a pivot axis Z and includes a short hair cutter assembly K as well as a long hair cutter assembly L associated therewith. VA identifies a vertical axis extending through the shaving head 2 which, as a symmetry axis, divides the shaving head into two parts of equal size. G₁ denotes a straight line applied to the outer edge of the inclined long hair cutter assembly L as well as to the outer contour of the short hair cutter assembly K, while β defines

the angular position of the long hair cutter assembly L relative to the straight line G_1 . Further details of possible configurations of the shaving head 2, in particular its bearing structure, are shown in FIGS. 2 to 6.

FIG. 2 is a longitudinal sectional view of the shaving head 2 and the upper part of the housing 1 of the shaving apparatus of FIG. 1. Provided on the housing 1 are two support lugs 4 and 5 between which the shaving head 2 is pivotally carried about the pivot axis Z. To limit the extent of swivelling motion of the shaving head 2, guide grooves 8 and 9 are formed in the two narrow end walls 6 and 7, respectively, of the shaving head 2, for engagement by guide pins 10 and 11, respectively, provided on the support lugs 4 and 5, respectively. A vibratory bridge 12 is provided between and secured to the narrow end walls 6 and 7, the bridge being caused to oscillate in a reciprocating motion by a drive member 13 extending out of the housing 1. The vibratory bridge is provided with a coupling means 14 for operating a long hair cutter assembly L not shown, in addition to including a further coupling means 15 for operating a short hair cutter assembly K comprised of a lower cutter 16 and an upper cutter 17. The shaving head 2 is pivotally mounted about the pivot axis Z, being carried in bearing bores 20 and 21 in the support lugs 4 and 5, respectively, by means of two bearing pins 18 and 19, respectively, provided on the narrow end walls 6 and 7, respectively. The pivot axis Z extends level with the outer contour of the upper cutter of the short hair cutter assembly K through the center axes of the bearing bores 20 and 21 and the bearing pins 18 and 19. FIGS. 3 to 6 show schematically various embodiments and cooperative relationships of the short and long hair cutter assemblies K and L, respectively, including the axis centers of the pivot axis Z.

FIG. 3 shows an arcuate short hair cutter assembly K comprising a lower cutter 16 and an upper cutter 17 as well as a long hair cutter assembly L including two cutting edges L_1 and L_2 and comprising a cutter comb 22 and a blade 23. G_1 identifies a straight line applied to the outer edge of the cutting edge L_1 of the inclined long hair cutter assembly L and tangent to the outer contour of the short hair cutter assembly K. A defines the distance between the outermost tangent points B_1 and B_2 of the straight line G_1 tangent to the short hair cutter assembly K and the long hair cutter assembly L. A straight line G_2 intersects the straight line G_1 at right angles in the center of the distance A, providing the point of intersection SP.

The point of intersection SP represents the center of the pivot axis Z extending in the longitudinal direction of the shaving head 2 pivotally mounted on the housing 1 and serves as reference point for the neighboring range within which the pivot axis Z may also be provided. The arcuate short hair cutter assembly K includes an effective shearing area which, starting from the tangent point B₁, extends in either direction on the arc length, terminating at the limit point P₁ on the side of the arc remote from the long hair cutter assembly L. In limit point P₁, the lower cutter 16 and the upper cutter 17 are still operative in the sense of shearing or can still be used in this sense on account of their cuttable relative engagement. A connecting line V interconnecting the limit point P₁ and the tangent point B₂ intersects the straight line G₂. The resulting point of intersection SP₁ serves, in conjunction with the point of intersection SP of the straight lines G₁ and G₂, as reference point for the distance C which is the determining factor for an arrangement of the pivot axis Z above and below the straight line G₁.

The long hair cutter assembly L is arranged in the pivoted shaving head 2 at a predetermined angle β to the straight line G₁. The angular range of β is preferably between 5° and 25°. Arranging the long hair cutter assembly L in an inclined position relative to the straight line G₁ and thus relative to the short hair cutter assembly K produces a bow wave effect of the skin to be shaved, with the result that the skin surface is in particularly close engagement with both cutter assemblies which are thus put to use simultaneously in an optimum manner in the sense of performing a shearing operation.

In FIG. 3, like in FIGS. 4 to 6, the vibratory bridge 12 and the drive member 13 described with reference to FIG. 2 and causing both the lower cutter 16 and the blade 23 to oscillate in a reciprocating motion are illustrated in simplified form by a U-shaped yoke and a thick line.

The embodiment of FIG. 4 shows a shaving head 2 pivotally mounted about the pivot axis Z and comprising an arcuate short hair cutter assembly K and a long hair cutter assembly L arranged at an angle β relative to the straight line G₁, the long hair cutter assembly L having only one cutting edge L₁ provided on the opposite side of the short hair cutter assembly K. The pivot axis Z extends through the point of intersection SP of the straight lines G₁ and G₂ with the straight line G₂

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intersecting the straight line G_1 at right angles and in the center of the relative distance A of the tangent point B_1 to the tangent point B_2 . The tangent points B_1 and B_2 are obtained by applying the straight line G_1 to the outer contours of the arcuate short hair cutter assembly K and the long hair cutter assembly L , with the tangent point lying remotest from the tangent point B_1 being determinative as the tangent point B_2 in cases where the straight line G_1 has surface contact with the long hair cutter assembly L .

In the embodiment of FIG. 5, the shaving head 2 is in a middle position of its swivelling range as shown, for example, in FIG. 1. The long hair cutter assembly L provided with only one cutting edge L_1 is arranged in the shaving head 2 at a lower elevation relative to the outer contour of the short hair cutter assembly K , whereby the straight line G_1 applied to the outer contour of the short hair cutter assembly K as well as to the outer edge of the long hair cutter assembly L intersects the vertical axis VA at an angle α . By aligning the upper side surface of the cutter comb 22 horizontally or at right angles to the vertical axis VA , the comb extends at an angle β relative to the straight line G_1 . Accordingly, angles α and β are of identical magnitude in this embodiment. Such identity is, however, not an absolute requirement because the upper side surface of the cutter comb 22 may be aligned relative to the straight line G_1 in a position different from the one shown and, accordingly, assume an angular position different from angle α .

The shaving head 2 of FIG. 5 is pivotally mounted about the pivot axis Z which extends through the point of intersection SP of the straight line G_1 with the straight line G_2 which intersects the straight line G_1 at right angles in the center of the distance A . The cooperative relation of the vertically offset long hair cutter assembly L with the short hair cutter assembly K as shown and described herein is particularly conducive to a close engagement of both cutter assemblies of the shaving head 2 with the skin surface, producing a bow wave of the skin to be shaved as a result of which a substantially larger area of the skin is effectively exposed to the shaving action.

In the embodiment of FIG. 6, the shaving head 2 is pivotally mounted about a pivot axis Z extending in the longitudinal direction of the shaving head. The arcuate short hair cutter assembly K is provided intermediate two long hair cutter assemblies L and L' in a protruding

relationship thereto. The blades 23 of the long hair cutter assemblies L and L' as well as the lower cutter 16 of the short hair cutter assembly K are coupled to the drive mechanism of the dry shaving apparatus via the vibratory bridge 12 and the drive member 13 illustrated schematically. In this embodiment, the pivot axis Z of the shaving head 2 extends through the point of intersection SP of two straight lines G_3 and G_4 where G_3 is a straight line applied to the outer edge of the long hair cutter assembly L and to the outer contour of the short hair cutter assembly K, and G_4 is a straight line applied to the outer edge of the long hair cutter assembly L' and to the outer contour of the short hair cutter assembly K. The point of contact of the straight line G_3 with the outer edge of the long hair cutter assembly L is identified by tangent point B_1 , while the point of contact of the straight line G_4 with the outer edge of the long hair cutter assembly L' is identified by tangent point B_2 . As becomes apparent from this Figure, the pivot axis Z extending through the point of intersection SP in the longitudinal direction of the shaving head 2 intersects the vertical axis VA. In the embodiment of FIG. 6, the symmetrical arrangement of the two long hair cutter assemblies L and L' relative to the short hair cutter assembly K provided intermediate thereof ensures that one of the long hair cutter assemblies L or L' operates in combination with the short hair cutter assembly K in any direction of sliding movement of the shaving head 2 over the skin to be shaved.

The pivot axis Z of the movable shaving head 2 may be provided within a neighboring range around the point of intersection SP, this arrangement ensuring that the entire shearing area usable for a shave is placed in contact with the skin with the shaver housing held against the skin at customary angles, and that the shearing area or part of the usable shearing area does not become disengaged from the skin surface with varying directions of sliding motion of the shaving head over the skin surface. It is understood that an arrangement of the pivot axis Z in the neighborhood of the point of intersection SP requires that practical considerations be taken into account. In view of the influence variables to be considered including, for example, the arcuate contour of the short hair cutter assembly K, the angular position β of the long hair cutter assembly or long hair cutter assemblies L or L' relative to the straight line G_1 , the relative distance C of the point of intersection SP of the straight line G_1 with the straight line G_2 to the point of intersection SP₁ of the straight line G_2 with the connecting line V, the amount of friction of

short and long hair cutter assemblies relative to the skin surface and the area of the forces exerted by the shaving apparatus on the skin surface, the limits of a permissible relative distance of the pivot axis Z to the point of intersection SP can only be determined by practical tests for the individual embodiments concerned. Starting from the straight line G_1 , the neighboring range may cover the area below the straight line G_1 up to about half the distance C which is predetermined by the point of intersection SP of the straight lines G_1 and G_2 and the point of intersection SP_1 of the straight line G_2 with the connecting line V, while above the straight line G_1 it may extend up to about ten times the distance C defined in the foregoing. With due consideration of the influence variables identified above, it is also possible to relocate the pivot axis Z at a distance x from the straight line G_2 either in the direction of the tangent point B_2 on the straight line G_1 or below or above the straight line G_1 .

A practical embodiment in which the pivot axis Z of the shaving head 2 is relocated away from the straight line G_2 and thus from the point of intersection SP in the direction of the tangent point B_1 on the straight line G_1 is illustrated in FIG. 7 and will be explained in more detail in the following. FIG. 7 is a cross sectional view of the shaving head 2 and the upper part of the housing 1 of the shaving apparatus of FIGS. 1 and 2.

An exchangeable frame 26 is seated on shoulders 25 of the shaving head housing, which shoulders extend in the longitudinal direction of the shaving head 2, where it is removably held in position by means of springs 27. An upper cutter 17 comprised of a shaving foil is arched over and secured to the exchangeable frame 26. Parallel to the upper cutter 17, a long hair cutter assembly L including two cutting edges L_1 and L_2 is arranged in the exchangeable frame as a constituent part thereof. The long hair cutter assembly L is coupled to a coupling means 14 formed integrally with the vibratory bridge 12. The long hair cutter assembly L is configured as a double-edge cutter L_1 , L_2 positioned at an angle β to the straight line G_1 . The lower cutter 16 which is comprised of an arcuate cutter block is also coupled to the vibratory bridge 12 by a coupling means 15, the bridge being caused to oscillate by a drive member 13 extending out of the housing 1, the oscillating motion being transmitted via the coupling means 15 and 14 to the lower cutter 16 and, respectively, the blade 23 of the two cutter assemblies.

Reference character A denotes the distance between the outermost tangent points B_1 and B_2 of the straight line G_1 tangent to the short hair cutter assembly K and the long hair cutter assembly L, while G_2 identifies a straight line intersecting the straight line G_1 at right angles in the center of the distance A. The point of intersection of the straight lines G_1 and G_2 is identified by SP. In this embodiment, the pivot axis Z of the shaving head 2 is relocated in the direction of the tangent point B_1 at a distance x from the straight line G_2 or from the point of intersection SP, with the pivot axis Z intersecting the straight line G_1 . As described with reference to and shown in FIG. 2, the pivot axis Z is identical with the center axes of the bearing pins 18 and 19 by means of which the shaving head 2 is pivotally carried in the respective bearing bores 20 and 21 of the respective support lugs 4 and 5. In FIG. 7, the symmetry axis passing through the shaving head 2 is represented as the vertical axis VA. The distance x by which the pivot axis Z is displaced from the straight line G_2 in the direction of the tangent point B_1 is identical to the relative distance of the vertical axis VA to the straight line G_2 on the straight line G_1 . Accordingly, the pivot axis Z extends through the point of intersection of the straight line G_1 with the vertical axis VA whereby a particularly well balanced swivelling motion of the shaving head 2 is accomplished. In consequence, an application in which the pivot axis Z is relocated from the straight line G_2 in the direction of the vertical axis VA of a shaving head 2 is to be preferred.

Patent Claims

1. A dry shaving apparatus with a housing (1), a drive mechanism and a shaving head (2) including at least one arcuate short hair cutter assembly (K) and at least one long hair cutter assembly (L, L') associated therewith whose cutting area (L₁) on the side remote from the short hair cutter assembly (K) includes an angled outer edge (at B₂), characterized in that the shaving head (2) is pivotally mounted on the housing (1) about a pivot axis (Z) extending in the longitudinal direction of the shaving head (2), and that the pivot axis (Z) extends through the point of intersection (SP) of two straight lines (G₁, G₂), where

G₁ is a straight line tangent to the outer edge of the cutting area (L₁) of the long hair cutter assembly (L) as well as to the outer contour of the arcuate short hair cutter assembly (K),

G₂ is a straight line intersecting the straight line (G₁) at right angles in the center of the distance (A), with

A being the distance between the outermost tangent points (B₁, B₂) of the straight line (G₁) tangent to the long hair cutter assembly (L) and the short hair cutter assembly (K).

2. The shaving apparatus according to the preamble of patent claim 1, characterized in that the shaving head (2) is pivotally mounted on the housing (1) about a pivot axis (Z) extending in the longitudinal direction of the shaving head (2), that the pivot axis (Z) is provided in the neighboring range of the point of intersection (SP) of two straight lines (G₁, G₂), and that the neighboring range lies above a connecting line (V), where

G₁ is a straight line tangent to the outer edge of the cutting area (L₁) of the long hair cutter assembly (L) as well as to the outer contour of the arcuate short hair cutter assembly (K),

G₂ is a straight line intersecting the straight line (G₁) at right angles in the center of the distance (A), with

A being the distance between the outermost tangent points (B₁, B₂) of the straight line (G₁) tangent to the long hair cutter assembly (L) and the short hair cutter assembly (K), and



V being the connecting line between the lower limit point (P_1), remote from the tangent point (B_1), of the effective shearing area of the short hair cutter assembly (K) and the tangent point (B_2).

3. The dry shaving apparatus as claimed in claim 1 or claim 2, characterized in that in the middle position of the pivotally mounted shaving head (2) the straight line (G_1) intersects at right angles a vertical axis (VA) extending as a symmetry axis through the shaving head (2).

4. The dry shaving apparatus as claimed in claim 1 or claim 2, characterized in that in the middle position of the pivotally mounted shaving head (2) the straight line (G_1) intersects at a predetermined angle α a vertical axis (VA) extending as a symmetry axis through the shaving head (2).

5. The dry shaving apparatus as claimed in any one of the preceding claims, characterized in that the long hair cutter assembly (L) is configured as a single-edge cutter.

6. The dry shaving apparatus as claimed in any one of the preceding claims, characterized in that the long hair cutter assembly (L) is configured as a double-edge cutter.

7. The dry shaving apparatus as claimed in any one of the preceding claims, characterized in that the long hair cutter assembly (L) is aligned relative to the straight line (G_1) at a predetermined angle β .

8. The dry shaving apparatus as claimed in any one of the claims 2 to 7, characterized in that the pivot axis (Z) is provided below the straight line (G_1) on the straight line (G_2) by an amount corresponding to at least half the relative distance (C) of the straight line (G_1) to the connecting line (V) in the region of the straight line (G_2).

9. The dry shaving apparatus as claimed in any one of the claims 2 to 7, characterized in that the pivot axis (Z) is provided above the straight line (G_1) on the straight line (G_2) by an amount corresponding to at least ten times the relative distance (C) of the straight line (G_1) to the connecting line (V).



10. The dry shaving apparatus as claimed in any one of the claims 2 to 7, characterized in that the pivot axis (Z) is provided at a distance (x) to the straight line (G_2).

11. The dry shaving apparatus as claimed in claim 10, characterized in that the pivot axis (Z) is provided at a distance (x) to the straight line (G_2), said distance corresponding to the relative distance of the straight line (G_2) to the vertical axis (VA).

12. The shaving apparatus according to the preamble of patent claim 1, characterized in that the shaving head (2) is pivotally mounted on the housing (1) about a pivot axis (Z) extending in the longitudinal direction of the shaving head (2), that the short hair cutter assembly (K) is provided intermediate two long hair cutter assemblies (L, L') in a protruding relationship to said long hair cutter assemblies (L, L'), and that the pivot axis (Z) extends through the point of intersection (SP) of two straight lines (G_3 G_4), where

G_3 is a straight line tangent to the outer edge of the cutting area (L_1) of the one long hair cutter assembly (L) as well as to the outer contour of the arcuate short hair cutter assembly (K), and

G_4 is a straight line tangent to the outer edge of the cutting area (L_2) of the other long hair cutter assembly (L') as well as to the outer contour of the arcuate short hair cutter assembly (K).

13. The shaving apparatus according to the preamble of patent claim 1, characterized in that the shaving head (2) is pivotally mounted on the housing (1) about a pivot axis (Z) extending in the longitudinal direction of the shaving head (2), that the short hair cutter assembly (K) is provided intermediate two long hair cutter assemblies (L, L') in a protruding relationship to said long hair cutter assemblies (L, L'), and that the pivot axis (Z) extends in the neighboring range of the point of intersection (SP) of two straight lines (G_3 G_4), where

G_3 is a straight line tangent to the outer edge of the cutting area (L_1) of the one long hair cutter assembly (L) as well as to the outer contour of the arcuate short hair cutter assembly (K), and



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G₄ is a straight line tangent to the outer angled edge of the cutting area (L₂) of the other long hair cutter assembly (L') as well as to the outer contour of the arcuate short hair cutter assembly (K).

14. The dry shaving apparatus as claimed in any one of the preceding claims, characterized in that the cutters of the short hair cutter assembly (K) and of the long hair cutter assemblies (L, L') are adapted to be jointly coupled to the drive mechanism of the dry shaving apparatus via a coupling block carried in the shaving head (2).

15. The dry shaving apparatus as claimed in any one of the preceding claims, characterized in that the shaving head (2) is pivotally carried about the pivot axis (Z) between two support lugs (4, 5) provided on the housing (1).

16. The dry shaving apparatus as claimed in any one of the preceding claims, characterized in that the pivot axis (Z) intersects the vertical axis (VA) at right angles.

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