

This invention relates to an electric shaving apparatus having a housing and a shaving head system which is adapted to pivot relative to the housing about a pivot axis and comprises a shaving head frame, a shearing plane which is formed by at least one upper cutter and has arcuate extensions towards the longitudinal sides of the shaving head frame, and at least one lower cutter which is driven by a motor and in cooperative relation with the upper cutter, in accordance with the features contained in the preamble of patent claims 1 or 2.

From US-A-2,099,537 a shaving head is known which is pivotally mounted on the hand grip of a shaving apparatus and has one and, alternatively, two planar shearing surfaces extending parallel to each other. In the shaving head disclosed in US-A-2,099,537, the width of the shearing plane exposed to the contact pressure extends beyond the shearing range formed by upper and lower cutter. It is bounded by two rollers serving to protect the skin which are associated with the planar shearing range outside thereof and extending parallel to its longitudinal direction. As disclosed in FIG. 8 of US-A-2,099,537, the shearing plane has its pivot axis on the lever line connecting the center axes of the two rollers. On account of the distance between the shearing plane and the lever line extending parallel to the shearing plane and through the pivot axis, the forces bearing vertically on the shearing plane and the respective thrust at which the shearing plane is moved over the skin surface combine with the sliding friction to produce a torque which, in a sliding direction, turns the shearing plane into engagement with the skin surface, while in the direction opposite the sliding direction causing the shearing plane to disengage from the skin surface. This disengagement effect is bound to occur when the shaving apparatus comes in contact with the skin to be shaved through one of the rollers and is then moved over the skin.

The torque causing disengagement of the shearing plane from the skin surface becomes even greater if the pivot axis of the shearing plane is disposed below the lever line connecting the center axes of the two rollers, as becomes apparent from FIG. 4 of US-A-2,099,537. The disengagement effect of a shearing plane as set forth in the foregoing with reference to FIG. 8 of US-A-2,099,537 will also occur in the device of FIG. 3 of US-A-2,526,153. In this device, the shearing plane is formed by the tangent plane connecting the peripheries of the two circular shaving heads. The effective shearing area of the two arcuate extensions covers the range from the respective transition points of the shaving head frame to

the arcuate extensions and their tangent points to the shearing plane. In this device, the pivot axis for the lever arm connecting the two shaving heads is below the line interconnecting the transition points of the effective shearing areas of the arcuate extensions to the shaving head frame.

U.S. Design Patent No. 232,494 discloses a shaving apparatus of the type identified having a pivoted twin-head shaving system whose pivot axis, which is determined by the pivot radius shown, lies below the line interconnecting the transition points of the effective shearing areas of the arcuate extensions to the shaving head frame, with the result that, in dependence on the respective direction of movement of the shaving heads over the skin surface, invariably only one shaving head will remain in engagement with the skin surface whilst the other will become disengaged from the skin surface, even when the two shaving heads are specifically brought into engagement with the skin surface.

From DE-B-1,048,509 a shaving apparatus is known having at least two adjacent shaving heads with plane shearing surfaces, the heads being movably carried in a shaving head frame immovably mounted on a hand grip, with at least one the shaving heads being movable relative to the other in a manner enabling the shaving heads, in response to the contact pressure exerted on the skin, to assume automatically positions in which their shearing surfaces are either in the same plane or at a more or less large angle relative to each other. Such a control of the shaving head position in dependence on contact forces applied is based on the understanding that the hand grip with its shaving heads is pressed against the skin surface at nearly right angles, allowing only a small amount of angular freedom for the hand grip in order to ensure that all shaving heads are in engagement with the skin. When the rolled edges provided in the longitudinal direction are in contact with the skin, an engagement of the shearing surface with the skin surface is not allowed to occur with this known device.

It is an object of the present invention to pivotally mount the shaving head of a shaving apparatus in such a manner that the entire shearing area usable for a shave engages the skin surface with the shaver housing held against the skin at customary angles, and that disengagement of the shearing area or part of the usable shearing area from the skin surface is prevented from occurring with varying directions of sliding motion of

the shaving head over the skin surface. The entire usable shearing area is to follow the contour of the skin surface, independently of the individual forces bearing thereon.

According to the invention, this requirement is satisfied by the features identified in claim 1 or claim 2.

By mounting a shaving head system or a shaving head in the manner disclosed in the invention it is ensured that, within the customary angles at which the shaving head of a shaving apparatus is held against the skin surface, the optimum shearing area usable for a shave with the particular shaving head system employed is automatically moved into engagement with the skin surface in the form of a shearing plane and remains engaged therewith, regardless of the forces bearing thereon and varying directions of sliding motion of the shaving head over the skin surface. It is a particular advantage of this balanced mounting of the shaving head system that the respective force exerted through the hand grip of the shaver is evenly distributed over the effective shearing area following engagement of the shearing plane with the skin surface.

In a further embodiment of the invention, the pivot axis of the shaving head system is provided below the tangent on the straight line at a distance of up to half the relative distance of the tangent to the connecting line in the region of the straight line.

In another embodiment of the invention, the pivot axis of the shaving head system is provided above the tangent on the straight line at a distance of up to ten times the relative distance of the tangent to the connecting line in the region of the straight line.

In a still further embodiment, the pivot axis of the movable shaving head system may be provided at a distance from the straight line. Displacing the pivot axis in this manner causes an unbalanced condition of the mounting of the shaving head system, involving an uneven distribution of the respective force bearing on the shearing area or shearing plane divided by the pivot axis. Disengagement of the shearing area or shearing plane from the skin surface is prevented from occurring within a specific distance of the pivot axis to the

straight line. In all embodiments of the invention, the permissible distance cannot be calculated mathematically and, accordingly, has to be determined by practical tests.

In another modification of the last-mentioned embodiment, at least one spring is provided bearing upon the shaving head system.

In a particularly advantageous embodiment of the invention, a shaving head system enclosed on all sides is arranged to move about the pivot axis between two support lugs provided on the hand grip.

The all-enclosed shaving head system is comprised of the shaving head frame, at least the one upper cutter covering the shaving head frame on the cutting end and a bottom member covering the frame on the driving end, as well as at least the one lower cutter which is linearly reciprocable between the upper cutter and the bottom member.

The space in the interior of the all-enclosed shaving head system serves advantageously as a container collecting the hair dust which accumulates in the course of one or several shaves and can be easily removed by separating the bottom member from the shaving head frame.

For the purpose of limiting the movement of the shaving system pivoting about the pivot axis Z, two abutment stops are provided on the bottom member as well as a detent member which protrudes from the driving end of the hand grip and is actuatable by a switch.

For the transmission of motion from the drive member to the lower cutter, a drive plate is slidably mounted on the bottom member and provided with a drive groove for engagement by the drive member.

Preferably, the shaving head system is rotatably secured to the support lugs by means of two bearing pins or two mounting screws.

In another embodiment, the shaving head system is slidably guided in grooves provided in the support lugs by means of two guiding elements.

Further advantages and details of the invention will become apparent from the subsequent description in conjunction with the drawings showing some preferred embodiments. Referring to the drawings,

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FIG. 1 is a schematic view of a shaving head system showing the shearing plane and the straight line as well as arcuate extensions of symmetrical configuration;

FIG. 2 is a schematic view of a shaving head system having unsymmetrical arcuate extensions;

FIG. 3 is a schematic view of a shaving head system having unsymmetrical arcuate extensions deviating from a circular form;

FIG. 4 is a perspective view of a shaving apparatus having a shaving head system movable about the pivot axis Z;

FIG. 5 is a perspective view of a shaving head system shown in swung-out condition to provide a view of the bottom member;

FIG. 6 is a schematic view of a shaving head system representing a section through one upper cutter, two lower cutters and a shaving head frame;

FIG. 7 is a schematic view of a shaving head system representing a section through two upper cutters, two lower cutters and a shaving head frame;

FIG. 8 is a schematic view of a shaving head system representing a section through one upper cutter, one lower cutter and a shaving head frame;

FIG. 9 is a schematic view of a shaving head system representing a section through one upper cutter, one lower cutter and a shaving head frame;

FIG. 10 is a view, in section, of a bearing configuration for the pivot axis Z on one of the support lugs and one of the end walls of the shaving head frame;

FIG. 11 is a view, in section, of a bearing configuration for the pivot axis Z on one of the support lugs and one of the end walls of the shaving head frame; and

FIG. 12 is a perspective view of a shaving apparatus having its pivot axis Z above the shearing plane.

Referring now to FIG. 1, there is shown schematically an upper cutter 4 having arcuate extensions B_1 and B_2 towards the longitudinal sides 5 and 6 of a shaving head frame 3. In this embodiment, the arcuate

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extensions B_1 and B_2 are each part of the arc of a circle of identical radii. The tangent plane connecting the arcuate extensions B_1 and B_2 is an imaginary plane referred to as shearing plane SE in the following. The common tangent T_3 to the curved contours of the arcuate extensions B_1 and B_2 determines by means of the tangent points TP_1 and TP_2 the transition from the shearing plane SE to the arcuate extensions B_1 and B_2 on the one hand and, by the relative distance A of the tangent points TP_1 and TP_2 the width of the shearing plane SE on the other hand. The amount of longitudinal extension of the shearing plane SE parallel to the longitudinal sides 5 and 6 of the shaving head frame 3 is dependent on the frame length provided.

The effective shearing area of the arcuate extensions B_1 and B_2 is understood to be the area in which upper and lower cutters are active in the sense of shearing, or are in a position to become active in this sense, because upper and lower cutters are in cuttable relative engagement. In the embodiment of FIG. 1, the limit points P_1 and P_2 of the effective shearing area of the arcuate extensions B_1 and B_2 which points are on the side remote from the tangent points TP_1 and TP_2 are determined, for example, by the transition of the upper cutter 4 into the longitudinal sides 5 and 6 of the shaving head frame 3. The line interconnecting the limit points P_1 and P_2 is identified by reference character V, while the straight line intersecting both the connecting line V and the tangent T_3 is identified by reference character G.

The straight line G intersects the tangent T_3 at right angles in the center of the relative distance A of the tangent points TP_1 and TP_2 . The resultant point of intersection SP serves as the preferred center of the pivot axis Z and as reference point for the neighboring range within which the pivot axis Z may also be provided. As shown, the pivot axis Z extends through the point of intersection SP as well as in the shearing plane SE and in the longitudinal direction of the shearing plane SE parallel to the longitudinal sides 5 and 6 of the shaving head frame 3.

FIG. 2 is a schematic illustration of a shaving head system in which the arcuate extensions B_1 and B_2 are unsymmetrical. In this embodiment, the arcuate extensions B_1 and B_2 are each part of the arc of a circle of different radii. The common tangent T_3 to the curved contours of the arcuate extensions B_1 and B_2 determines by means of the tangent points TP_1 and TP_2 both the

transition from the shearing plane SE into the arcuate extensions B_1 and B_2 and, by means of the relative distance A of the tangent points TP_1 and TP_2 , the width of the shearing plane SE. In the embodiment of FIG. 2, the farthest points on the arcuate extensions B_1 and B_2 were chosen as the limit points P_1 and P_2 . Accordingly, the effective shearing area of the arcuate extension B_1 covers the range from P_1 via the vertex S_1 of the arcuate extension up to the tangent point TP_1 of the tangent T_3 applied to the arcuate extension B_1 , while the effective shearing area of the arcuate extension B_2 covers the range from the limit point P_2 up to the tangent point TP_2 of the tangent T_3 applied to the arcuate extension B_2 which point comes before the vertex S_2 . A straight line referred to as connecting line V connects the limit points P_1 and P_2 . In this embodiment, the width of the shearing plane SE is determined by the relative distance A of the tangent points TP_1 and TP_2 on the tangent T_3 . A straight line G drawn through half the distance A intersects the tangent T_3 at right angles in point SP. This point of intersection SP is the center of the pivot axis Z.

FIG. 3 is a schematic sectional representation of an upper cutter 4 and lower cutters 25 and 26 arranged in cooperative relation with the upper cutter. The arcuate extensions B_1 and B_2 of the upper cutter 4 which are unsymmetrical and deviate from a circular form project into the longitudinal sides 5 and 6 of the shaving head frame 3 and are fastened thereto. In the embodiment shown, the points P_1 and P_2 limiting the effective shearing area on the curved contours of the arcuate extensions B_1 and B_2 are the lower limit points of the given area of engagement of the equally arcuate lower cutters 25 and 26 with the upper cutter 4. As becomes apparent from the illustration, the curved contours of the lower cutters 25 and 26 usable for a cutting action end at points P_1 and P_2 whence they extend away from the upper cutter 4 into the interior of the shaving head frame 3. The straight line connecting the limit points P_1 and P_2 is identified as connecting line V.

The common tangent T_3 to the curved contours of the arcuate extensions B_1 and B_2 determines by means of the tangent points TP_1 and TP_2 both the transition from the shearing plane SE to the arcuate extensions B_1 and B_2 and, by means of the relative distance A of the tangent points TP_1 and TP_2 , the width of the shearing plane SE. The effective shearing area of the arcuate extensions B_1 and B_2 covers the range from the respective tangent

points TP_1 and TP_2 to the respective limit points P_1 and P_2 lying remote from the tangent points on the curved contours of the respective arcuate extensions B_1 and B_2 .

The straight line G intersects the tangent T_3 at right angles in the center of the relative distance A of the tangent points TP_1 and TP_2 . The resultant point of intersection SP is the center of the pivot axis Z of the shaving system.

Examinations of embodiments of shaving head systems movable relative to the housing and suitable for practical applications revealed an excellent pivot action of the shaving head system 2 with its shearing plane SE relative to the skin surface and an excellent skin contact if the pivot axis Z is arranged to extend through the point of intersection SP .

The pivot axis Z of the movable shaving head system 2 may be provided within a neighboring range around the point of intersection SP to be determined as set forth in the embodiments of FIGS. 1 to 3, 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, such as the curvature of the arcuate extensions B_1 and B_2 , the width of the shearing plane SE , the magnitude of the distance B between SP and SP_1 , as well as the friction and the force at which the shearing plane SE bears upon the skin surface. Therefore, the boundaries of the neighboring range as indicated in the following may be subject to restrictions in individual cases. Starting from the shearing plane SE bounded by the tangent points TP_1 and TP_2 , the neighboring range extends below the shearing plane up to about half the distance B predetermined by the point of intersection SP and the point of intersection SP_1 on the straight line G with the connecting line V , while extending above the shearing plane up to about ten times the distance B defined in the foregoing. Because of the invariably same relative distances of the center of the pivot axis Z to the tangent points TP_1 and TP_2 , a relocation of the pivot axis Z on the straight line G intersecting the tangent T_3 at right angles results in a balanced bearing of the shaving head system,

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with the effect that the respective force exerted through the shaver housing is evenly distributed over the entire area of the shearing plane following engagement of the shearing plane with the skin surface.

It is also possible to relocate the pivot axis Z at a relative distance to the straight line G both in the direction of the tangent point TP₁ and in the direction of the tangent point TP₂, providing it within the shearing plane or, alternatively, below or above the shearing plane. In such an embodiment, an unbalanced movement of the shearing plane SE or of the shaving head frame about this pivot axis Z will occur. As a result, following engagement of the shearing plane SE with the skin surface, the force exerted by the shaver will be distributed over the shearing plane unevenly, causing the shearing plane to engage the skin surface under unlike forces. The unbalanced movement of the shearing plane SE can be compensated for by at least one spring bearing upon the shaving head system. In view of the numerous influence variables to be considered including, for example, the curved contour of the arcuate extensions, the distance B between the points of intersection SP and SP₁ of the straight line G with the shearing plane and, respectively, the connecting line V, the friction of the upper cutter relative to the skin and the range of the forces exerted by the shaver on the skin, the limits of the permissible relative distance of the pivot axis Z to the straight line G can only be determined by practical tests for the individual embodiment concerned.

FIG. 4 shows a shaving apparatus having a housing serving as a hand grip 1 and a shaving head system 2 movable about a pivot axis Z and comprising a shaving head frame 3 and a shearing plane formed by a double-arched upper cutter 4 having arcuate extensions B₁ and B₂ towards the longitudinal sides 5 and 6 of the shaving head frame 3. The hand grip 1 accommodates an electric motor causing oscillation of a drive member 7 projecting out of the hand grip 1. The drive member 7 extends out of the end of the hand grip 1 referred to as the driving end 8 in the following and is adapted to be coupled either directly or indirectly to the lower cutter(s) not shown in FIG. 4. Details relating to configuration possibilities and the cooperative relationships between lower and upper cutters will become apparent from FIGS. 6 to 9. At the driving end 8, the narrow sides 9 and 10 of the hand grip 1 extend to form two projecting support lugs 11 and 12 providing a bearing for the pivoted shaving head frame 3.

In the shaving apparatus shown in FIG. 4, the hand grip 1 is made up of two housing assemblies 1.1 and 1.2 detachably held together by a locking mechanism to be operated by a locking button 13.

A switch 14 provided on the housing assembly 1.2 on the broad side of the hand grip 1 serves to operate a detent member 15.

FIG. 5 illustrates the housing assembly 1.2 of the hand grip 1 of FIG. 4, with the shaving head frame 3 shown in a position enabling the side of the shaving head frame 3 close to the driving end 8 to be visible. In this embodiment, the shaving head frame 3 is provided with a bottom member 16 held between the end walls 17 and 18 of the shaving head frame 3 in a detachable, that is, removable, manner by locking means 19 and 20. For the purpose of limiting the angular movement of the shaving head system or shaving head frame 3 of FIGS. 4 and 5 movable about the pivot axis Z, two stops 21 and 22 are provided in the bottom member 16 for abutment by the detent member 15 displaceable by the switch 14 in the extended position, while the shaving head frame 3 is free to pivot about the pivot axis Z through 360° with the detent member 15 in the retracted position.

A drive plate 23 coupled to the lower cutter(s) arranged in the shaving head frame 3 is slidably mounted on the bottom member 16. The drive plate 23 has a drive groove 44 for engagement by the drive member 7 for the purpose of transmitting motion from the motor to the lower cutter or cutters.

The shaving head frame 3 of FIGS. 4 and 5, in combination with the upper cutter 4 forming the shearing plane, the bottom member 16 and the lower cutter(s) arranged to oscillate between the upper cutter and the bottom member, forms a shaving head system 2 enclosed on all sides and being pivotally mounted between the support lugs 11 and 12 about the pivot axis Z, with the angular motion being limitable by means of a detent member 15 and abutment stops 21 and 22, such as to ensure the transmission of motion from the oscillating drive member 7 to the lower cutter or cutters when the shaving apparatus is being used.

FIGS. 6 to 9 show schematically various modifications of embodiments of, and cooperative relationships between, upper cutter and lower cutter in a shaving head frame 3.

FIG. 6 shows an upper cutter 4 which is arched over the circular contours of two lower cutters 25 and 26 and is secured to the longitudinal sides 5 and 6 of the shaving head frame. A guide roller 24 is arranged between the lower cutters 25 and 26 such that, with the upper cutter 4 being guided around the guide roller 24, a U-shaped depression is obtained between the two lower cutters. The guide roller 24 extends parallel to the longitudinal sides 5 and 6 and is movably carried in the end walls 17 and 18 in a longitudinal guiding means 29, such as a groove, provided at right angles to the shearing plane SE when not swung out. A coupling block 27 transmitting the oscillating motion of the drive to the lower cutters 25 and 26 is disposed on the bottom member 16 abutting the longitudinal sides 5 and 6. The tangent plane connecting the arcuate extensions B_1 and B_2 and bounded by the tangent points TP1 and TP2 and, respectively, their tangent lines extending in the longitudinal direction of the shaving head frame 3 and by the length of the upper cutter 4, is an imaginary plane referred to as shearing plane SE in the present invention. Based on the mounting of the upper cutter in the longitudinal sides 5 and 6 of the shaving head frame 3, the limit points P_1 and P_2 of the effective shearing area of the arcuate extensions B_1 and B_2 on the side remote from the tangent points TP1 and TP2 are the points of first contact of the circumference of the lower cutters 26 and 25 with the upper cutter. A bore 28 is provided in the end wall 17 to carry the pivot axis Z. The center axis of the bore 28 is at the same time part of the pivot axis Z and lies a small amount below the shearing plane SE in the embodiment of FIG. 6. In the use of the shaver, with the lower cutters 25 and 26 spring-mounted on the coupling block 27 in the vertical direction, or with the coupling block 27 spring-loaded in the vertical direction, the contact pressure of the shaver against the skin surface will cause a displacement of the shearing plane SE relative to the pivot axis Z, so that the shearing plane SE will intersect the pivot axis Z horizontally at least intermittently.

Unlike the shaving head system of FIG. 6, the shaving head system of FIG. 7 shows two upper cutters 4.1 and 4.2 arched over the circular contours of two lower cutters 25 and 26. Upper cutter 4.1 is secured to the longitudinal side 6 of the shaving head frame and guided around the lower cutter 26 until it is in abutment with the guide roller 24 intermediate the two lower cutters 25 and 26. Upper cutter 4.2 which is secured to the longitudinal side 5 is guided around the lower cutter 25 until it abuts the guide roller 24. The guide roller 24 and

the two upper cutters 4.1 and 4.2 are firmly connected with each other, for example, by welding or riveting. The guide roller 24 is slidably carried in the guiding means 29 as described with reference to FIG. 6.

According to FIG. 8, the shaving head system includes one upper cutter 4 and one lower cutter 30. The lower cutter 30 is made up of two hemispherical cutter heads 31 and 32 connected by a bridge structure 33 to form an integral element. The lower cutter 30 is coupled to the coupling block 27 and vertically movable thereon or therewith against a spring means not shown, as described with reference to FIG. 6. The upper cutter 4 is tensed around the shown contour of the lower cutter 30 and is secured in the longitudinal sides 5 and 6 of the shaving head frame 3. The guide roller 24, which is slidably carried in a guiding means 29 and has the upper cutter 4 guided around it, ensures the necessary engagement of the upper cutter 4 with the lower cutter 30 or the engagement of the spring-mounted lower cutter 30 with the upper cutter 4.

FIG. 9 shows a shaving head system having an upper cutter 4 tensed over a lower cutter 34. The sides extending longitudinally of the lower cutter 34 are arcuate towards the longitudinal sides 5 and 6 of the shaving head frame 3 in order to form the arcuate extensions B_1 and B_2 from the shearing plane SE for the overlying upper cutter 4. In this embodiment, the underside 35 of the lower cutter 34 coincides with the connecting line V passing through the mid-points M_1 and M_2 and connecting the points P_1 and P_2 on the arcuate extensions B_1 and B_2 . When conforming the contour of the lower cutter to the shearing plane SE which connects the tangent points TP_1 and TP_2 lying vertically above the center axes of the mid-points M_1 and M_2 , a lower cutter structure results having two arcuate shearing areas and a plane shearing area in combination with the upper cutter 4 tensed over the lower cutter. A bore 28 serving to receive the pivot axis Z is provided in the end wall 17. The center axis of the bore 28 which is at the same time the pivot axis Z lies level with the shearing plane SE in the end wall 17. Accordingly, the pivot axis Z extends through the shearing plane. In the use of the shaver, with the lower cutter 34 spring-mounted or with the coupling block 27 spring-loaded in the vertical direction, the contact pressure of the shaver against the skin surface will cause a displacement of the shearing plane SE into the region below the pivot axis Z, which displacement amounts to the travel of the spring.

FIGS. 10 and 11 show, by way of example, two embodiments of the bearing configuration for the pivot axis Z of the shaving head system, the bearing being shown on one of the support lugs of FIG. 4. FIG. 10 shows, partly in section, the support lug 11, the end wall 17, the bottom member 16 and the upper cutter 4, as well as a lower cutter. On the inside of the support lug 11, the bore 28 is provided in the manner of a blind-end hole, while a through bore 36 is provided in the end wall 17. A bearing pin 37 extending through the through bore 36 and formed fast therewith engages into the bore 28 in which it is rotatably carried. In the embodiment shown, the pivot axis Z extends through the center axes of the through bore 36 and the bore 28, lying level with the shearing plane SE of the upper cutter 4. The support lug 12 of the hand grip 1 and the end wall 18, which are not shown, are provided with an analogous bearing configuration.

In FIG. 11, the support lug 11 is slightly offset relative to the narrow side 9 of the hand grip 1. The support lug 11 extends into the interior of the shaving head frame 3, being partially embraced by the end wall 17. A through bore 36 and a tapped hole 38 are provided in the end wall 17 and the support lug 11, respectively. A mounting screw 39 provided with a step 45 to rotatably carry the end wall 17 and thus the shaving head system extends through the through bore 36 and is threaded into the tapped hole 38. The support lug 12 of the hand grip 1 and the end wall 18, which are not shown, are provided with an analogous bearing configuration. The pivot axis Z extends through the center axes of the through bores 36 and the tapped bores 38 of the support lugs 11 and 12.

FIG. 12 shows a shaving apparatus having a housing serving as a hand grip 1 and a shaving head system 2 movable about the pivot axis Z and comprising a shaving head frame 3 and a shearing plane SE formed by a double-arched upper cutter 4 with arcuate extensions B₁ and B₂ extending towards the longitudinal sides 5 and 6 of the shaving head frame 3. Extending from the narrow sides 9 and 10 of the hand grip 1, two projecting support lugs 11 and 12 are provided to movably carry the shaving head frame 3 about the pivot axis Z which lies above the shearing plane SE.

The pivot axis Z extending in the longitudinal direction of the shaving head system 2 intersects the straight line G, which in turn intersects both the shearing plane SE at point SP and the connecting line V, above the shearing plane at a distance lying within the

specified neighboring range around the point of intersection SP. This range may be up to ten times the relative distance B of the points of intersection of the straight line G with the shearing plane SE on the tangent T_3 and the connecting line V.

The shaving head frame 3 is movably carried by means of guiding elements 40 and 41 in respective grooves 42 and 43 provided in the respective support lugs 11 and 12, with both the guiding elements 40 and 41 and the respective grooves 42 and 43 being of an arcuate configuration corresponding to the radius r measured from the pivot axis Z.



Patent Claims

1. An electric shaving apparatus having a housing (1) and a shaving head system (2) which is adapted to pivot relative to the housing (1) about a pivot axis (Z) and comprises a shaving head frame (3), a shearing plane (SE) which is formed by at least one upper cutter (4) and has arcuate extensions (B_1 , B_2) towards the longitudinal sides (5, 6) of the shaving head frame (3), and at least one lower cutter (25, 26, 30, 34) which is driven by a motor and in cooperative relation with the upper cutter (4), characterized in that the pivot axis (Z) extends through the point of intersection (SP) of two straight lines (T_3 , G), where T_3 is the common tangent applied to the arcuate extensions (B_1 , B_2), G is a straight line intersecting the tangent (T_3) at right angles in the center of the distance (A), and A is the distance between the tangent points (TP_1 , TP_2) of the tangent (T_3) applied to the arcuate extensions (B_1 , B_2).

2. The electric shaving apparatus according to the preamble of patent claim 1, characterized in that the pivot axis (Z) extends in the neighboring range of the point of intersection (SP) of two straight lines (T_3 , G) and that the neighboring range lies above a connecting line (V), where T_3 is the common tangent applied to the arcuate extensions (B_1 , B_2), G is a straight line intersecting the tangent (T_3) at right angles in the center of the distance (A), A is the distance between the tangent points (TP_1 , TP_2) of the tangent (T_3) applied to the arcuate extensions (B_1 , B_2), and V is the connecting line between the lower limit points (P_1 , P_2) of the effective shearing area of the arcuate extensions (B_1 , B_2), which points are remote from the tangent points (TP_1 , TP_2).

3. The shaving apparatus as claimed in claim 2, characterized in that the pivot axis (Z) is provided below the tangent (T_3) on the straight line (G) at a distance of up to half the relative distance (B) of the tangent (T_3) to the connecting line (V) in the region of the straight line (G).

4. The shaving apparatus as claimed in claim 2, characterized in that the pivot axis (Z) is provided above the tangent (T_3) on the straight line (G) at a distance of up to ten times the relative distance (B) of the tangent (T_3) to the connecting line (V) in the region of the straight line (G).



5. The shaving apparatus as claimed in claim 2, characterized in that the pivot axis (Z) is provided at a distance from the straight line (G).

6. The shaving apparatus as claimed in claim 5, characterized in that at least one spring is provided bearing upon the shaving head system (2).

7. The shaving apparatus as claimed in claim 1 or claim 2, characterized in that the shaving head frame (3) is enclosed on all sides by means of a bottom member (16) covering it on the driving end.

8. The shaving apparatus as claimed in claim 7, characterized in that a drive plate (23) is slidably mounted on the bottom member (16).

9. The shaving apparatus as claimed in claim 8, characterized in that the drive plate (23) is provided with a drive groove (44).

10. The shaving apparatus as claimed in claim 7 or claim 8, characterized in that two abutment stops (21, 22) are provided on the bottom member (16).

11. The shaving apparatus as claimed in claim 10, characterized in that a detent member (15) is provided which cooperates with the abutment stops (21, 22), extends out of the housing (1) and is actuatable by a switch (14).

12. The shaving apparatus as claimed in one or several of the preceding claims, characterized in that the shaving head system (2) is arranged between two support lugs (11, 12) provided on the housing (1).

13. The shaving apparatus as claimed in claim 12, characterized in that the shaving head system (2) is pivotally secured to the support lugs (11, 12) by means of two bearing pins (37) or two mounting screws (39) (FIGS. 10, 11).

14. The shaving apparatus as claimed in claim 12, characterized in that the shaving head system (2) is slidably guided in grooves (42, 43) provided in the support lugs (11, 12) by means of two guiding elements (40, 41) (FIG. 12).