Jan. 17, 1967 R. W. MacCARTHY 3,298,101

COUNTER-ROTATING HEAD ELECTRIC RAZOR

Filed March 30, 1964 3 Sheets-Sheet 1

FIG. 1.

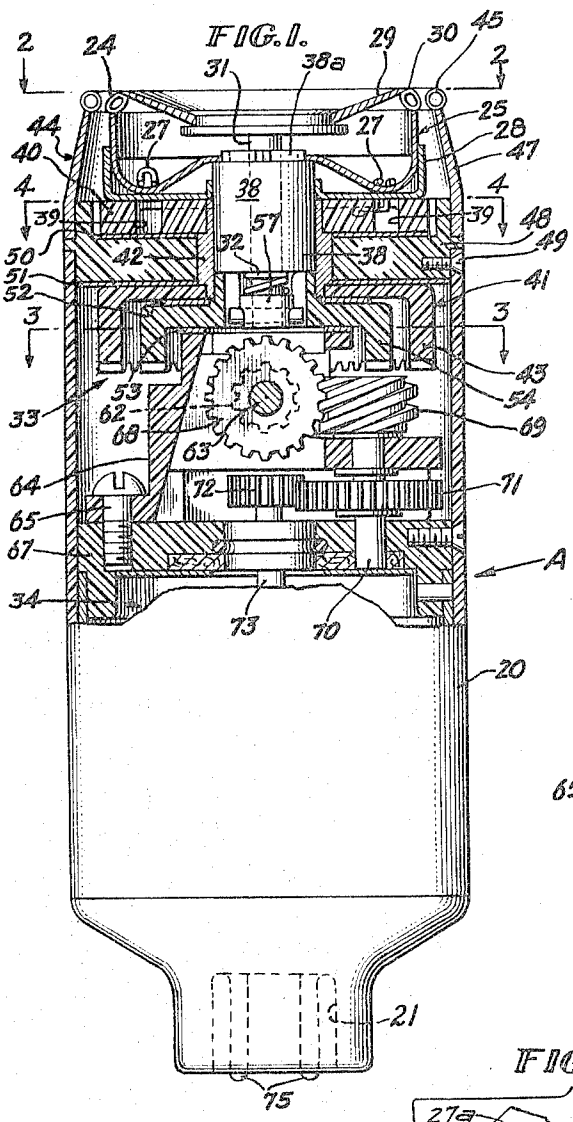


FIG. 2.

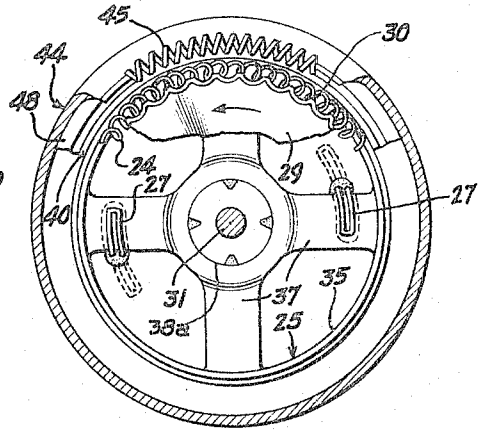


FIG. 3.

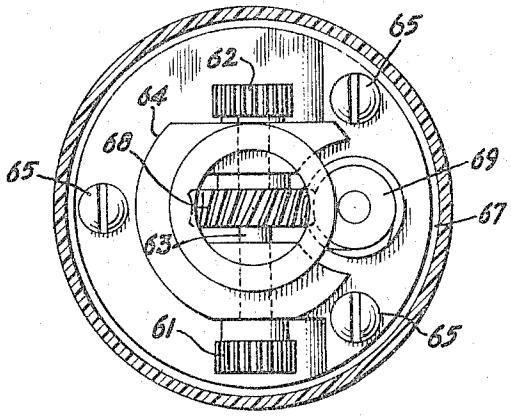


FIG. 4.

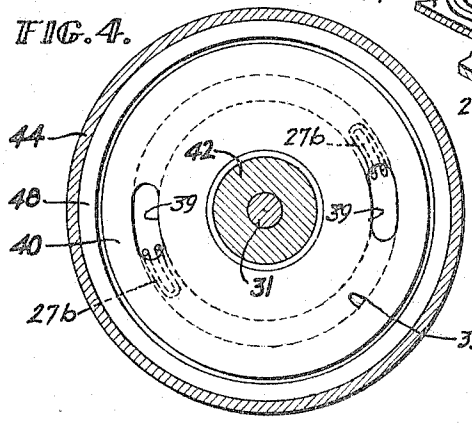


FIG. 5.

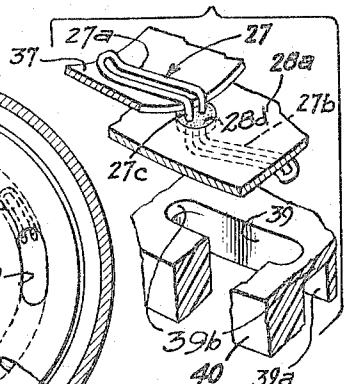
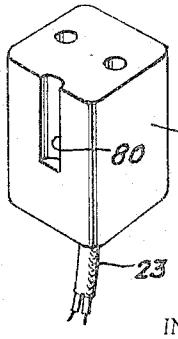


FIG. 6.



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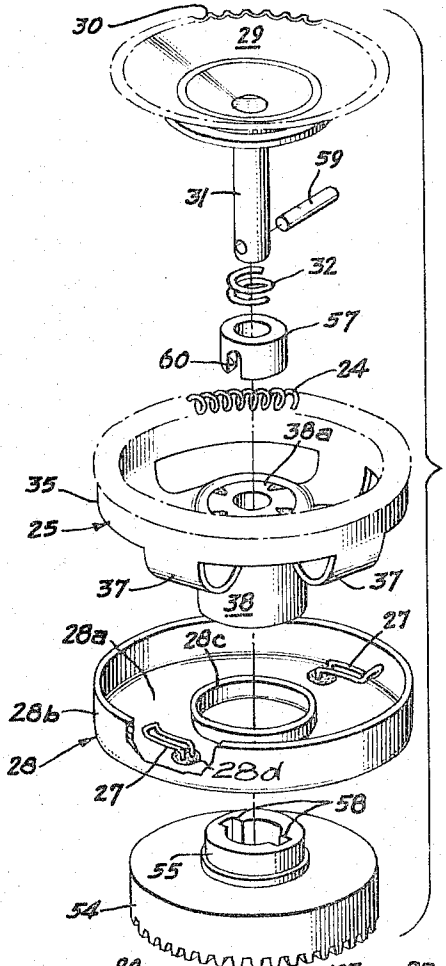


FIG. 7.

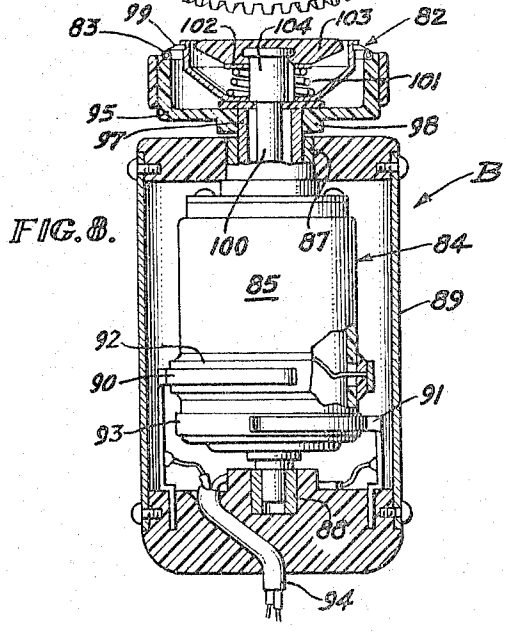


FIG. 8.

FIG. 10.

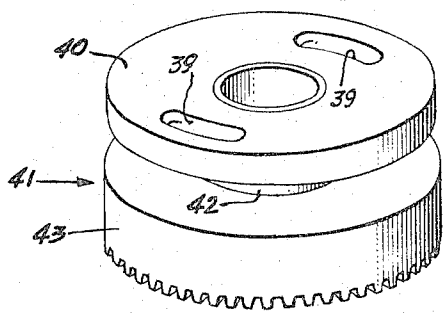
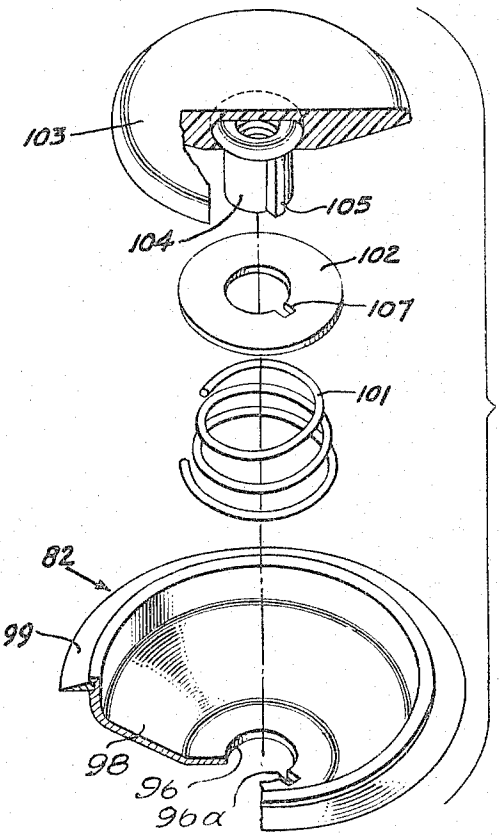


FIG. 9.



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FIG. 11.

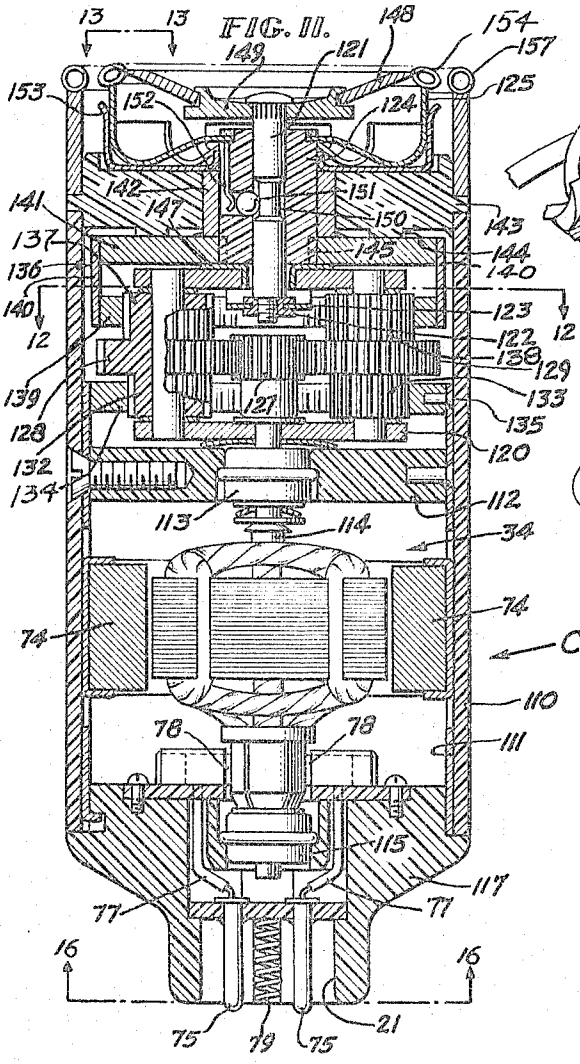


FIG. 13.

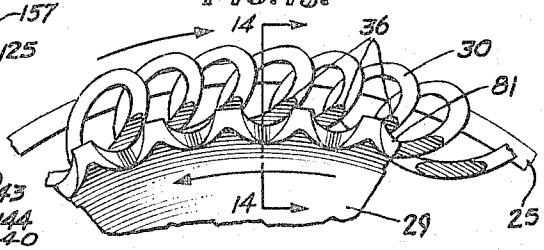


FIG. 14.

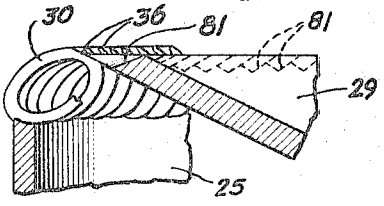


FIG. 15.

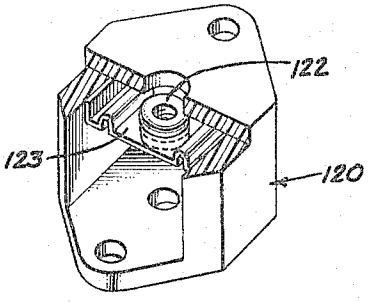


FIG. 12.

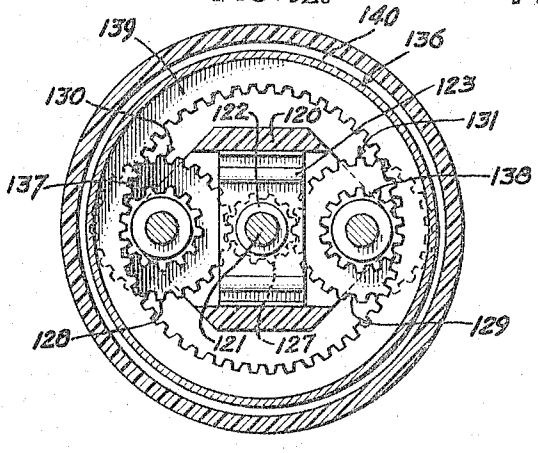
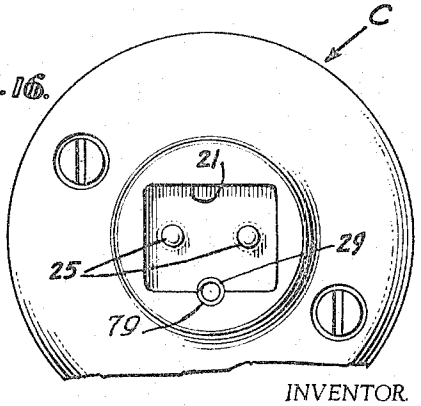


FIG. 16.



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United States Patent Office 3,298,101
Patented Jan. 17, 1967

3,298,101

COUNTER-ROTATING HEAD ELECTRIC RAZOR

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Filed Mar. 30, 1964, Ser. No. 355,659
5 Claims. (Cl. 30—43.5)

The present invention relates to a power driven safety razor, and pertains more particularly to such a razor having a generally circular blade with an axially outward marginal surface thereof exposed, the blade being mounted co-axially of a blade back-up member comprising a helical coil of wire formed into a ring and having a surface on each convolution thereof, the surfaces on all convolutions defining a common surface conforming to and in light contact with an axially inward marginal surface area of the blade, means being provided for driving the blade back-up member rotatively relative to the blade and to the skin of a user.

In the past, a considerable amount of thought and effort has been given to the development of power driven safety razors. This effort has been directed along two principal lines, (1) to develop a razor employing a slicing type blade wherein the slicing blade edge is moved slidably along the skin to slice off whiskers at the skin level, and (2) to develop a razor employing a clipper type action, wherein the clipping action occurs as near as possible to skin level. Since the latter clipper type mechanism employs two superposed blades, with the underlying one thereof interposed between an outer blade and the user's skin, the effort in the latter case has been directed principally toward a reduction in the thickness of the underlying blade to a minimum.

In my Patent No. 3,220,108, issued November 30, 1965 there is disclosed a power driven razor wherein a toothed, annular back-up member is provided with a ring of radially inclined teeth underlying and backing up the peripheral slicing edge of a rotary disk blade.

An object of the present invention is to provide a further improvement in this general type of rotary blade, slicing type of power driven safety razor.

Another object of the invention is to provide an improved safety razor having a rotatively driven, disk type blade peripherally sharpened to a slicing edge, with the sharpened periphery of the blade riding on a blade back-up member having a circularly arranged row of radially and axially inclined back-up teeth thereon, and rotatively driven in a direction opposite to that of blade rotation for drawing whiskers into the path of the blade edge, and for supporting the whiskers while they are being sliced off by the blade at skin level.

A further object of the invention is to provide a rotary blade safety razor having an improved blade structure.

A further object of the invention is to provide an improved safety razor wherein a toothed blade back-up member comprises a helical coil of wire formed into a ring and mounted to back up the sharpened peripheral slicing edge of a rotary circular blade, a portion of each convolution of the coil helix being ground off along a common surface to conform to a marginal surface portion of the blade.

A further object of the invention is to provide an improved blade and back-up ring structure for a rotary blade razor.

A further object of the invention is to provide an improved rotary blade safety razor having a generally circular blade with a serrated, peripherally sharpened, slicing edge rotating relatively to an annular, toothed, blade back-up member.

These, and other objects and advantages of the invention, will be apparent from the following description and the accompanying drawings, wherein:

FIG. 1 is a view, partly in side elevation and partly in diametrical section, of a preferred form of the present invention.

FIGS. 2, 3 and 4 are sectional views taken along lines 2—2, 3—3 and 4—4, respectively, of FIG. 1.

FIG. 5 is an enlarged, fragmentary, perspective view of portions of the bottom of the whisker cup and an arm of the blade back-up support spider, and showing one of the spring wire clips which releasably interconnect these members to the outer cup shaped gear unit of the razor shown in FIG. 1.

FIG. 6 is a perspective view of an electrical contact plug for use with the razor of FIG. 1, a fragment of a two conductor cord being included.

FIG. 7 is an exploded, perspective view of the blade and back-up ring assembly of the razor shown in FIGS. 1–5, 7, 10, 13, 14, and 16.

FIG. 8 is a diametrical sectional view of a razor embodying a modified form of the invention.

FIG. 9 is an enlarged, exploded, perspective view of the blade assembly of the razor shown in FIG. 8.

FIG. 10 is a perspective view of the outer, inverted cup shaped gear assembly which drives the blade back-up ring in the razor of FIG. 1.

FIG. 11 is a diametrical sectional view of a further modified form of the invention.

FIG. 12 is a transverse sectional view taken along line 12—12 of FIG. 11.

FIG. 13 is an enlarged, fragmentary, end elevational view looking in the direction of the arrows 13—13 of FIG. 11.

FIG. 14 is a sectional view taken along line 14—14 of FIG. 13.

FIG. 15 is an enlarged, perspective view of the gear cage shown in FIGS. 11 and 12, a portion thereof being broken away.

FIG. 16 is an end elevational view looking in the direction of the arrows 16—16 of FIG. 11.

Briefly, in the form of the invention shown in FIGS. 1–5, 7, 10, 13, 14, and 16 a rotary blade safety razor A comprises a housing **20** having a plug socket **21** in the lower end thereof for receiving the plug **22** (FIG. 6) of a conductor cord **23**. Throughout the present description, the various parts of the illustrative embodiments of the invention will be described in their axially upright position, as shown, for example, in FIGS. 1, 7, 9 and 10. Also, with the exception of the inter-engagement of the blade and the back up ring, where two relatively moving parts are in bearing engagement with each other, either one of the parts is of plastic and the other is of metal, or the parts are separated by a low-friction washer, which may be of Teflon.

On the upper end of the housing **20** (FIG. 1) a toothed blade-back-up ring **24**, preferably made from a helical coil of wire, is securely mounted on the upper end or rim of a cupped spider **25**, which is removably attached by clips **27** to a whisker cup **28**.

A circular blade **29**, in the form of a shallow, truncated cone, has its periphery sharpened to a keen cutting edge **30**. The blade **29** is mounted on a spindle **31**, and is biased by a light, coil compression spring **32** toward peripherally seated condition on a conforming surface defined by faces **36** formed, as by grinding, on the convolutions of the blade back-up ring **24**. The blade **29** and the blade back-up ring **24** are driven rotatively in opposite directions through gearing **33** actuated by a drive motor **34**.

Referring to the drawings in greater detail, and considering first the preferred form of the invention illustrated in FIGS. 1–7, 10, 13, 14, and 16, the blade back-up ring **24** is made from a helical coil of a good grade of steel wire, preferably surgical or cutlery steel, which may

be stainless. The coil 24, before hardening and heat treating, is subjected to a distorting pressure transversely of its axis, so that the convolutions thereof are tilted forwardly slightly in the direction of forward ring rotation, in the manner best shown in FIGS. 2 and 11.

Various parts of the herein described razors are fixedly secured together, and since many suitable ways are known for securing such parts together, it will be understood that any suitable securing means may be employed for this purpose, such as for example, cementing, as with epoxy resin, welding, brazing, silver soldering, or other as desired.

The ring-shaped helical coil for the back-up ring is heat treated as required to provide desired edge-taking and holding characteristics in a manner well known to those familiar with the art, and is affixed co-axially onto the upper rim of the cup-shaped spider 25. The convolutions of the helical coil of the back-up ring 24 are ground off to provide the faces 36 (FIGS. 13 and 14) which define a common surface conforming to the lower or inner peripheral surface portion of a blade 29 seated thereon.

The cup-shaped spider 25, upon which the blade back-up ring 24 is mounted, comprises a spider rim portion 35 (FIG. 7) with four integral spokes 37 connecting the rim to a hub portion 38. The latter is fitted onto the reduced upper end of a hub extension member 38*a*, and is fixedly secured co-axially thereon.

The whisker cup 28 for receiving whiskers severed during a shaving operation may be a light weight annular pan shaped member with a flat, bottom portion 28*a*, integral, cylindrical outer wall 28*b*, and upturned inner rim 28*c*, the latter of which fits onto the hub extension 38*a*. The outer wall 28*b* overlaps, and fits around, the lower edge of the spider rim portion 35.

The flat bottom portion 28*a* of the whisker cup 28 has the two spring wire clips 27 (FIGS. 1, 2, 5 and 7) mounted therein. These clips are in the form of narrow, elongated, closed loops. Each clip 27 comprises an upper half portion 27*a* and a lower half portion 27*b*, which are offset from each other, medially of the length of the clip by a mid-section 27*c*. The lower half portion 27*b* of each clip lies beneath the whisker cup bottom portion 28*a*, and is spaced slightly therefrom. The offset medial portions 27*c* of the clips pass through holes provided therefor in diametrically opposite relation in the whisker cup bottom portion 28*a*, and are fixedly secured in plugs 28*d* filling these holes. The top half portion 27*b* of each clip is spaced upwardly slightly from the whisker cup bottom portion to receive a spoke 37 of the spider 25 therebeneath. The free ends of each clip upper and lower half portions are bent outwardly slightly.

The lower half portion 27*b* of each clip 27 is insertible in a circumferentially elongated hole 39, two of which are provided in diametrically opposite relation in the flange 40 of a unitary outer gear assembly 41. With the lower halves of the clip portions 27*b* inserted in the two elongated holes 39 thus provided, the whisker cup may be moved rotatively about its axis to advance the lower clip half portions 27*b* beneath a thin web 39*b*, provided by making an annular groove 39*a* co-axially in the under side of a flange portion 40 of an outer gear unit 41 (FIGS. 1 and 10).

The outer gear assembly 41, which drives the back-up ring 24 and its associated parts, comprises the disk-like top flange portion 40, a central interconnecting sleeve portion 42, and an inverted, cup-shaped outer gear portion 43. The interconnecting sleeve portion 42 has upper and lower end portions of reduced diameter as shown in FIG. 1, onto which are fitted and secured, respectively, the top flange portion 40 and the outer gear portion 43.

A stretcher ring 44 surrounds the blade back-up ring 24 in radially spaced relation thereto. This stretcher ring 44 rides along the skin of a user ahead of the leading edge of the blade 29 during a shaving operation, and, by frictional engagement with the skin, tends to tauten it and to erect the whiskers thereon at their moment of slicing engagement by the blade edge. The illustrated stretcher ring 44 comprises a helical coil 45 of suitable wire, such as stainless steel, secured co-axially onto the upper end of a short sleeve 47. The latter is mounted with a light frictional fit in a rabbeted recess provided therefor around a housing head member 48, which may be of plastic, and which is secured by screws 49 in the upper end of the housing 20. An axial opening through the head member 48 provides a journal support for the interconnecting sleeve portion 42 of the outer gear unit 41. A low-friction washer 50, which may be of Teflon, is interposed between the top flange portion 40 of the outer gear assembly 41 and the housing head member 48, while other similar washers 51, 52 and 53 are mounted between other relatively rotating parts of the mechanism to prevent undue friction.

The gearing 33 for driving the blade 29, and at the same time driving the back-up ring 24 at a slower rate of speed in the opposite direction, comprises, in addition to the outer gear assembly 41, an inner, inverted, cup-shaped gear 54. The latter is provided with an elongated, upwardly extending gear hub 55, which is journaled in the sleeve portion 42 of the outer, inverted, cup-shaped gear assembly 41. An axial opening is provided in the gear hub 55 of a size to receive therein a notched spring retainer 57 (FIGS. 1 and 7) which is slipped onto the lower end of the blade spindle 31 after the latter has been inserted in the axial opening provided therefor in the spider hub extension 38*a*. A pair of keyways 58, best shown in FIG. 7, are provided lengthwise along diametrically opposite sides of the axial opening in the gear hub 55 to receive the projecting end portions of a through-pin 59, which is removably inserted with a sliding fit in a hole provided therefor transversely of the lower end portion of the blade spindle 31 to drive the latter upon rotation of the inner inverted cup shaped gear 54.

End notches 60 in the spring retainer 57 are saddled on the through pin 59, and the light coil spring 32 encircles the blade spindle 31 and is held in compression between the spring retainer 57 and the spider hub extension 38*a* to bias the peripheral portion of the lower or inner face of the blade 29 lightly onto the ground faces 36 (FIGS. 13 and 14) of the back-up ring 24, which faces, as mentioned previously herein, are shaped to define a common surface conforming to the marginal portion of the blade riding thereon.

The inner inverted cup-shaped gear and the outer gear assembly 41 are driven co-axially in opposite directions, and at different speeds, by two spur pinions 61 and 62, which are mounted one on each end of a transverse shaft 63. The latter is journaled in a gear pedestal 64, which is secured by screws 65 to a transverse central housing partition 67 (FIGS. 1 and 3). The top of the gear pedestal 64 bears lightly against the under side of the inner cup-shaped gear 64 to prevent downward axial displacement of the latter.

As best shown in FIG. 3, the transverse shaft 63 and its pinions 61 and 62 are so located that the pinion 61 meshes with the outer gear portion 43, while the pinion 62 meshes at a diametrically opposite point with the inner gear 54. The drive pinions 61 and 62 may be of equal pitch diameter, but since the outer cup gear portion 43 is of larger diameter than the inner cup gear 54, the latter will be driven at a higher r.p.m. than the former. Suitable speeds for the two gears 41 and 54 are 250 r.p.m. and 350 r.p.m., respectively, but the gear ratios and resultant rotative speeds of these gears is not material to the invention and may be varied as required, to provide desired rotative speeds of the blade and back-up ring, respectively. For example, a speed of 60 r.p.m. or less has been found suitable for the back-up ring.

A worm gear 68 is mounted on the transverse shaft 63 to ride in the central recess of the gear pedestal 64, and

this worm gear **68** is in mesh with a worm pinion **69** (FIG. 1) mounted on a shaft **70** and turning freely in a lateral opening provided therefor in the gear pedestal **64**. The worm pinion shaft **70** is journaled in aligned bearing openings provided therefor in the gear pedestal **64** and in the central housing partition **67**. A spur gear **71**, mounted on the worm pinion shaft **70** and extending through a lateral opening provided therefor in the lower end of the gear pedestal **64** meshes with a spur drive pinion **72** mounted on the drive shaft **73** of the motor **34**.

A number of drive motors well suited to the purpose are well known and are readily available, such as, for example, the direct current electric motor **34** shown in FIGS. 1 and 11. This type of motor has usual permanent field magnets **74**, and a suitable rectifier and transformer (not shown) may be incorporated in a wall plug in a well known manner to transform alternating to direct current. Since the drive motor per se is not a feature of the invention, and since any suitable electric, spring wound, inertia, or other type of motor may be employed, a detailed explanation of the motor is omitted.

To avoid the use of a switch for starting, stopping and, if desired, reversing the motor when an electric motor is employed, the plug socket **21** (FIG. 11) is provided with a pair of conventional contact prongs **75** (FIGS. 1 and 11) mounted therein. These prongs, as best shown in FIG. 11, are connected to conductors **77** leading to the motor brushes **78**.

A helical coil compression spring **79**, of sufficient strength to eject the plug **22** from its socket **21** when the plug is inserted in motor-reversing position, is embedded to half its diameter in a groove **80** provided therefor along one side of the enclosure defining the socket **21**. The plug **22** is of a size and cross sectional shape to fit slidably into the socket **21**, and the groove **80** is of a size to receive the projecting half of the spring key **79** freely therein when the plug is inserted in the socket in "forward-run" position.

For momentarily reversing the motor **34** when required, the plug **22** can be forced into the socket in a relatively reversed position by compressing the spring **79**, and when the spring-compressing force is removed, the spring ejects the plug from its socket. This arrangement prevents continuous operation of the motor **34** in a reverse direction.

The operation of the razor A shown in FIGS. 1–6, 7 and 10 is as follows:

With the razor assembled as shown in FIG. 1, and the conductor cord **23** connected to provide a suitable source of electrical current at the plug **22**, where the latter is inserted fully into the socket **21** with the spring key **79** fitted into the plug groove **80**, the motor **34** rotates in its forward direction, and, by means of the gearing **33**, drives the blade **29** rotatably in one direction as indicated by the arrow in FIG. 2, and at the same time drives the blade back-up ring **34** preferably more slowly in the opposite direction.

In using the razor A, with the motor running to rotatably drive the blade at a desired speed in its forward direction, and the back-up ring preferably but not necessarily more slowly in the opposite direction, the upper or blade end of the razor is applied to the face, either substantially perpendicularly or at a slight forward angle of inclination thereto, and is moved to draw the leading peripheral slicing edge **30** of the blade across the skin and in contact therewith. During such movement the stretcher ring **44** smooths and tautens the skin slightly in advance of the blade to assist in erecting the hairs or whiskers thereon.

As the razor is thus advanced, the whiskers move relatively into the inter-convolution spaces of the helical coil of the rotatively moving blade back-up ring **24**, where the angular position and relative transverse movement of the teeth formed by the convolutions of the back-up ring helix urge the whiskers into engagement with the peripheral slicing edge of the rotating blade **29**. The slight frictional engagement with the user's skin of the upper or outer surface of the rotating blade also tends to urge each inter-convolutional or inter-tooth portion of the skin, and the whiskers growing thereon, toward the next adjacent convolution of the helical back-up ring **24** in the direction of blade rotation. When the whiskers are thus brought into engagement with such tooth or convolution, the latter will back up the whiskers and support them to facilitate the slicing off of the whiskers close to the skin by the keen slicing edge **30** of the blade.

Although a very satisfactory shave can be obtained with a blade having a circular peripheral slicing edge of the general type shown in FIG. 9, it is preferred that the peripheral slicing edge of the blade be serrated slightly, as best illustrated in FIGS. 13 and 14, and that the leading edge of each serration **81** be preferably inclined at substantially the same angle to a radius from the axis of blade rotation as the longitudinal center line of each ground surface **36** on the teeth of the back-up ring **24**. Such a serrated edge tends to have a combined shearing and slicing action on the whiskers at the skin level, and permits an effective shaving operation to be performed with a blade considerably duller than would be possible with a blade having an unserrated cutting edge.

For disassembling the blade end of the razor A, the stretcher ring **44** may be removed by grasping it and withdrawing it endwise from its seat in the housing **20**. The entire blade and back-up ring assembly can then be removed by grasping the spider **25**, turning it axially in a relatively rearward direction to release its spokes **37** from beneath the upper portions **27***a* of the clips, and axially withdrawing the spider, together with the blade, from the housing **20**. Whiskers which have accummulated in the whisker cup **28** can then be blown lightly therefrom. If desired, the whisker cup can be removed by turning it sufficiently, also in a rearward direction, to release the lower portions **27***b* of the wire clips from their position beneath the web **39***b* (FIG. 5). The parts can be reassembled by reversing the above procedure.

To remove the blade **29** for sharpening or replacement, after removal of the blade and back-up ring assembly as described in the preceding paragraph, the through pin **59** can be withdrawn from its hole in the blade spindle **31** to free the spindle for axial withdrawal from the notched spring retainer **57**, blade biasing spring **32** and spider **25**.

In the modified form B of the invention shown in FIGS. 8 and 9, relative rotation between a circular blade **82** and a blade back-up ring **83** is produced by inertial reaction between the usual armature, not shown, of an electric motor **84**, and the usual field assembly thereof, also not shown. The motor housing **85**, which is secured to the field assembly to rotate therewith, is journaled for free rotation in bearings **87** and **88** mounted co-axially in opposite ends of a razor housing **89**. Contact brushes **90** and **91** ride on wipe rings **92** and **93**, respectively, in the motor housing **85** to provide electrical contact between the usual motor brushes (not shown) and the wires of a conductor cord **94**.

The blade back-up ring **83**, which may be an annular helical coil substantially similar to that **24** employed in the form of the invention illustrated in FIGS. 1–6, 7 and 10 described in detail previously herein, is mounted on the upper end of a cup shaped support member **95** which is mounted co-axially on a tubular axial extension **97** of the motor housing **85** to rotate therewith.

The blade **82**, best shown in FIG. 9, comprises a cup-shaped blade hub portion **98**, and a peripherally shapened, annular blade portion **99** fixedly secured co-axially thereto. The blade hub portion is provided with an axial hole **96**, and a notch **96***a* opens into this hole. A light, tapered helical spring **101** is mounted in compression between the upper side of the blade hub portion **98** and the under side of a metal washer **102**, which has bearing engage-

ment with the underside of a plastic button **103**. The latter is fitted, preferably for slight wobble and free relative rotative movement, onto the upper end of a button hub portion **104**, which is internally threaded and screws onto the threaded upper end of the motor drive shaft **100** for rotation therewith when the motor is driven in "forward run" direction.

A key **105** provided along a side of the button hub portion **104** fits into a notch **107** opening into the axial hole of the washer **102**, and also into the similar notch **96***a* in the blade hub portion **98**. Thus the button hub **104**, rotating with the motor shaft **100**, drives the blade **82** and the washer **102** by means of the key **105**, while frictional engagement between the washer **102** and the button **103** urges the latter rotatively in the same direction.

In operating the razor B shown in FIGS. 8 and 9, with the motor **84** running in its "forward run" direction, the razor is held and is applied to a user's face, and is moved therealong as described previously herein for the razor A shown in FIG. 1.

The motor shaft **100**, as explained previously herein, drives the blade **82** rotatively in one direction, while the counter-rotative force or reaction exerted on the motor housing **85** in thus driving the shaft **100** by inertial reaction urges the motor housing **85**, and with it the blade back-up ring **83** mounted thereon, rotatively in the opposite direction. The relative rates of rotation of the blade and backup ring may obviously be varied by increasing or decreasing the relative weights of the armature and motor housing, and the pressure of the razor against the skin of the user.

In the further modified form C of the invention shown in FIGS. 11–16, a housing **110**, generally similar to that **20** shown in FIG. 1, has a cylindrical metal sleeve **111** fitted therein which houses the motor, which may be the direct current motor **34** referred to previously herein. A central partition **112** supports one bearing **113** of the motor drive shaft **114**, the other motor shaft bearing **115** being mounted in a housing lower end member **117**. The latter member has the plug socket **21** therein illustrated and described previously herein.

A rotary gear cage **120** (FIGS. 11 and 15) is journaled on the motor drive shaft **114**, while a blade spindle **121** is screwed into a nut **122** mounted on a light leaf spring **123** in the upper end of the gear cage **120**. The blade spindle thus rotates with the gear cage **120**, and is journaled in the hub extension **124** of a blade back-up ring spider **125** to provide journal support for the upper end of the gear cage **120**.

A drive pinion **127** is secured co-axially on the upper end of the motor drive shaft **114**, and is in mesh with the central gear elements **128** and **129** of a pair of identical triple gears **130** and **131**. The latter are journaled in the gear cage **120** in similar position, in axially parallel relation, and on diametrically opposite sides of the drive pinion **127**.

The lower gear elements **132** and **133** of the triple gears **130** and **131** are in mesh with an internally toothed, fixed, ring gear **134**, which is secured by pins **135** co-axially within the upper end of the motor sleeve **111**, while the upper gear elements **137** and **138**, which are of larger pitch diameter than the lower gear elements **132** and **133**, are in mesh with an internally toothed, rotatable ring gear unit **136**. The latter is of larger pitch diameter than the fixed ring gear **134**.

The rotary ring gear unit **136** as illustrated is a unitary assembly, consisting of a ring gear element **139** secured co-axially within the lower end of a tubular rim element **140**, while within the upper end of this rim element is secured a disk element **141** having a tubular hub element **142** secured co-axially thereto. The hub element **142** of the ring gear unit **136** is journaled in an axial opening provided therefor in a head member **143** of the housing **110**, and the disk element **141** is in bearing engagement with an annular rib **144** provided therefor on the under surface of the head member **143**.

The disk element **141** has a splined opening axially thereof, indicated by the dotted lines **145** in FIG. 11, and the lower end of the spider hub extension **124** is splined to fit slidably therein. The unsplined upper portion of the spider hub extension **124** fits slidably into the tubular hub portion **142** of the upper ring gear unit **136**, and rotates therewith. A bearing washer **147**, having a downturned flange surrounding the central opening therein, is fitted into a central opening provided therefor in the upper end of the gear cage **120**, the central opening of the washer **147** being of a size to admit the blade spindle **121** freely therein.

A shallow, conical blade **148**, having a keen, slicing peripheral edge, preferably serrated as shown in FIGS. 13 and 14, is affixed co-axially onto a blade hub **149**, which in turn is fixedly mounted co-axially on the blade spindle **121**. A medial portion **150** of the blade spindle **121** is of reduced diameter, and serves as a detent to receive a spring pressed ball **151** mounted in a radial hole in the spider hub extension **124** to prevent the spindle from dropping out in the event it should be unscrewed from its nut **122** in inverted position. A spring finger **152**, mounted in a recess provided therefor lengthwise of a side of the hub extension **124**, urges the ball **151** radially inwardly.

The leaf spring **123** in the gear cage **120** exerts a light, tensile force on the blade spindle **121** to urge the blade **148** axially downwardly into light, bearing relation with the conforming faces **36** formed on the individual convolutions of the back-up ring coil as shown in FIG. 11, and as described previously herein for the form of the invention shown in FIG. 1.

A whisker cup **153**, similar to the whisker cup **28** of the form A of the invention shown in FIG. 1, is fitted onto the blade back-up ring spider **125**, and is provided with a flanged axial opening for receiving the spider hub extension **124** therein.

Upon inserting in the socket **21**, in its "forward run" position, a contact plug **22** (FIG. 6) connected to a suitable source of electrical current, the motor drive pinion **127** rotatably drives the gear cage **120** about its axis by advancing the triple gears **130** and **131** around the interior of the fixed ring gear **134**. The blade spindle **121**, being screwed into the spring mounted nut **122**, and the blade **148** mounted thereon, rotate with the gear cage **120** in one direction. Since the upper gear elements **137** and **138** and the rotary ring gear element **139**, are, as mentioned previously herein, of larger pitch diameter than the lower gear elements **132** and **133** and the fixed ring gear **134**, respectively, the ring gear unit **136**, and with it the back-up ring spider **125**, and whisker cup **153** mounted thereon, are thus rotatably driven in the opposite direction.

A stretcher ring **157**, generally similar to that **44** shown in FIG. 1, is fitted, with a light frictional fit, into a recess provided therefor in the housing upper end member **143**.

The razor C shown in FIGS. 11–16 is used in the same manner as that described previously herein for the other herein illustrated forms A and B of the invention. When the motor **34** is operated in its normal, forward direction for shaving, the nut **122** tends to screw itself firmly onto the blade spindle **121**, thus exerting the light resilient bias of the spring **123** axially on the blade to hold it in conforming engagement with the back-up ring. The action of the blade on the conforming portions of the back-up ring tends to constantly sharpen the blade edge.

For removing the blade **148**, a user may grasp the housing **110** with the thumb and three fingers on one hand, place the index finger of the same hand lightly on the blade hub portion **149** to resist rotation of the blade, and force the contact plug **22** (FIG. 6) into the socket **21** in relatively reversed position. This drives the motor in reverse, whereupon the gear cage **120**, and with

it the nut **122**, are rotatably driven in a direction to cause the nut to unscrew itself from the blade spindle. When the spindle is thus freed from the nut **122**, the blade **148** may be withdrawn axially upwardly, bringing with it, due to the action of the spring pressed ball **151**, the spider **125** and whisker cup **153**. The blade may then be removed from the hub extension **124** by holding the latter and pressing upwardly on the lower end of the blade spindle with sufficient force to overcome the resistance offered by the spring pressed ball **151**. The whisker cup may also be removed from the spider, and any whiskers in the former may be either dumped or blown out by a light breath of air by the user. The parts may be reassembled by reversing the above procedure.

The invention provides an improved and highly effective razor, and one wherein whiskers are removed by slicing them off at the skin level, without danger of nicking or cutting the skin, and without any transverse crushing action on the individual hairs or whiskers. The novel blade back-up ring provides an accurate toothed structure without the necessity of cutting the teeth by machining, and requires only the dressing off of the surfaces of the convolutions of the helical coil as shown in FIG. 11 to provide an accurate seating surface for the back or inner face of the blade. Although the blade is shown in FIGS. 1, 7, 11 and 14 in the form of a shallow truncated cone with serrated slicing teeth, it is obvious that in either of these structures a flat or disk type blade may be employed by grinding the blade contacting faces of the back up ring teeth so that the blade will conform thereto. The novel arrangement of the back-up ring spider and whisker cup is also an advantageous and ingenious structure, although obviously other types of support for the back-up ring will be readily apparent to any ordinarily skilled worker in the art.

While I have illustrated and described a preferred embodiment of the present invention, and two modified forms thereof, it will be understood, however, that various changes and modifications may be made in the details thereof without departing from the scope of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is defined in the following claims.

1. A rotary blade razor comprising
a housing
a blade having a generally circular sharpened peripheral slicing edge mounted for rotation on the housing and with a marginal portion of the axially outward side of the blade adjacent the slicing edge exposed exteriorly of the housing for sliding conforming contact with the skin of a user during a shaving operation,
a blade back up ring comprising a helical coil of wire formed into a ring mounted co-axially of the blade on the axially inward side thereof
a surface formed on each convolution of the coil, such surfaces defining a common annular surface facing a blade and conforming with an axially inward, marginal portion of the blade, each of the surfaces formed on the convolutions of the coil extending transversely across the slicing edge of the blade,
means lightly biasing the conforming surfaces of the coil into conforming engagement with a marginal portion of the axially inward side of the blade, across and
drive means for driving the back up ring rotatively relative to the blade.

2. A rotary blade razor comprising
a housing
a rotary blade of generally circular shape having a sharpened peripheral slicing edge and mounted for rotation on the housing with the axially outward side of the marginal portion of the blade exposed exteriorly of the housing,
a blade back up ring support spider journaled for rotation in the housing axially inwardly of, and co-axially of the blade,
a blade-up ring comprising a helical coil of wire formed into an annulus and mounted co-axially on the end of the spider facing the blade,
a surface formed on the side of each convolution of the coil facing the blade, each of said surfaces being shaped to conform with an axially inward marginal portion of the blade,
means lightly biasing the blade conforming surface portions of the coil into conforming engagement with a marginal portion of the axially inward side of the blade, each such coil surface portion extending transversely of the cutting edge of the blade, and
drive means mounted to drive the spider and the blade back-up ring mounted thereon rotatively relative to the blade.

3. A rotary blade razor comprising
a housing
a blade back-up ring support spider comprising a hub portion and an axially outwardly facing co-axial cylindrical rim portion journaled in the housing,
a blade back up ring comprising a helical coil of wire formed into an annulus and mounted co-axially on the axially outward end of the spider rim portion,
a blade spindle journaled co-axially in the spider hub portion,
a generally disk like blade mounted on the outer end of the spindle axially outwardly of the back-up ring, the periphery of the blade being sharpened to a keen slicing edge,
a surface formed on the side of each convolution of the blade back up ring facing the blade, all of such surfaces defining a common surface shaped to conform with an axially inward, marginal portion of the blade,
means lightly biasing the conforming surface portions of the coil into engagement with a marginal portion of the axially inward side of the blade, each such coil surface portion extending transversely of the cutting edge of the blade,
drive means for driving the blade and the back up ring, and
gearing operatively interconnecting the drive means to the blade and to the back up ring for rotatively driving the blade back up ring relative to the blade.

4. A rotary blade razor as claimed in claim **3** wherein a whisker cup has an axial opening in the bottom thereof to receive the spider hub portion and is fitted onto the axially inward end of the spider, the whisker cup having also a marginal rim of a height and internal diameter to receive the axially inward end of the rim of the spider therein to prevent the escape therebetween of whiskers severed by the blade during a shaving operation.

5. In a safety razor, in combination with a blade having a keen slicing edge,
means mounting the generally circular blade with a marginal portion on one side of the blade adjacent the slicing edge exposed for sliding movement along the skin of a user,
a blade back-up member comprising a helical coil of round wire formed into a ring of an internal diameter smaller than that of the blade, and of an external diameter larger than that of the blade,
a surface on each convolution of the helical coil extending substantially chordally of such convolution, all of said surfaces defining a common surface shaped to conform to the other side of said marginal portion of the blade, and
means biasing the blade and back-up ring axially toward each other to fit said other side of the marginal portion of the blade into close conforming relation with

said surfaces on the convolutions of the coil of the back-up ring.

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