# United States Patent [19]

**Brenneman et al.**

[11] **3,858,314**

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[54] **DRIVE ASSEMBLY FOR AN ELECTRIC SHAVER**


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[73] Assignee: **Schick Incorporated,** Lancaster, Pa.



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[52] **U.S. Cl.** ..... **30/43.92**

[51] **Int. Cl.** ..... **B26b 19/02**

[58] **Field of Search** ..... 30/43.92, 42, 4 A, 44, 30/45



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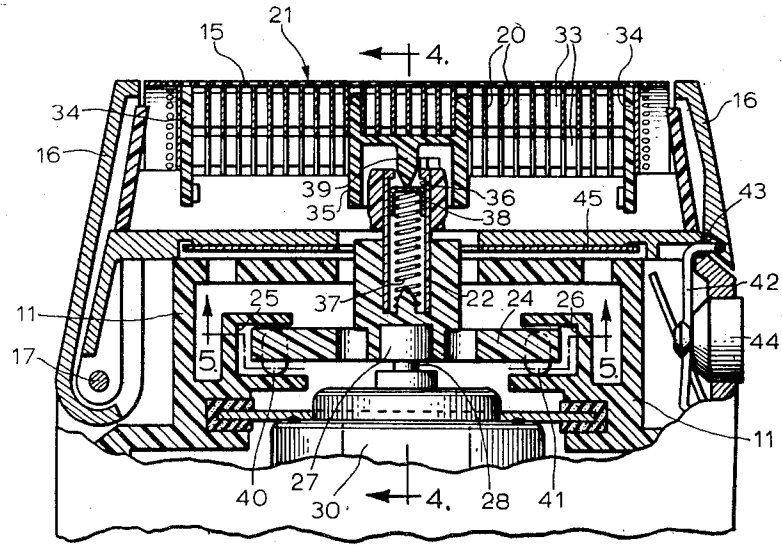
*Primary Examiner*—Al Lawrence Smith
*Assistant Examiner*—Margaret M. Joyce

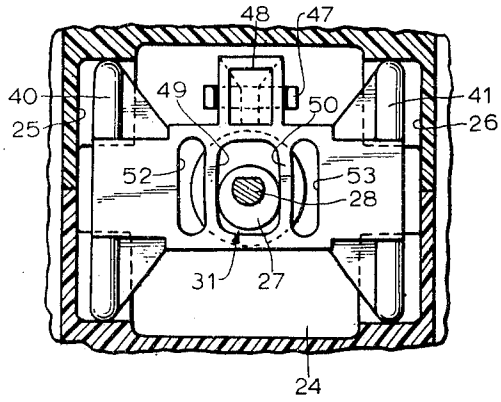


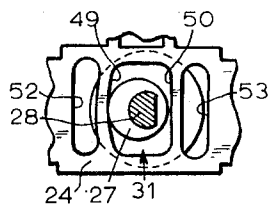
[57] **ABSTRACT**

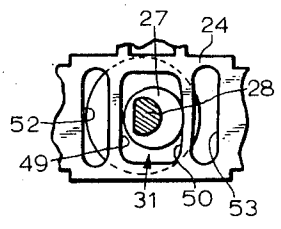
A drive assembly for an electric razor of the type having a motor and a reciprocatively driven blade assembly comprises an actuator member mechanically coupled to the blade assembly. An eccentric drive cam rotatably driven by the motor engages a drive slot provided in the actuator member to reciprocatively drive the actuator member and the blade assembly. Relief slots are provided in the actuator member on either side of the drive slot to render the walls of the drive slot flexible to accommodate dimensional variations in the drive slot or drive cam resulting from wear or normal production tolerances in these elements.


**6 Claims, 8 Drawing Figures**



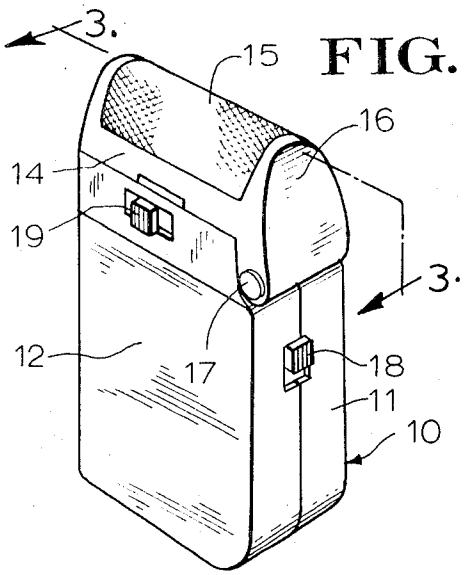



FIG. 1

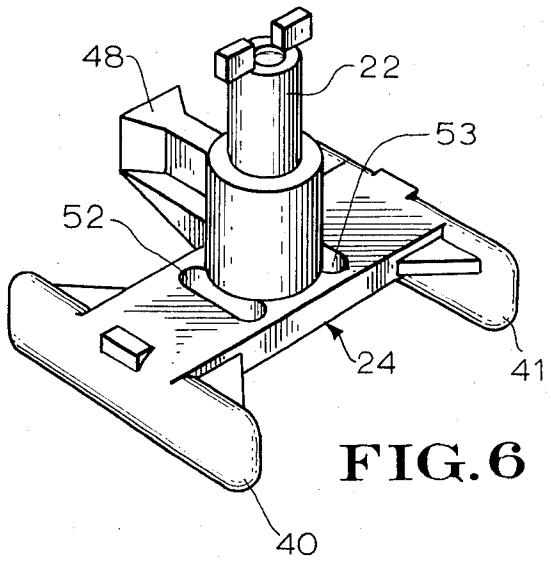



FIG. 6

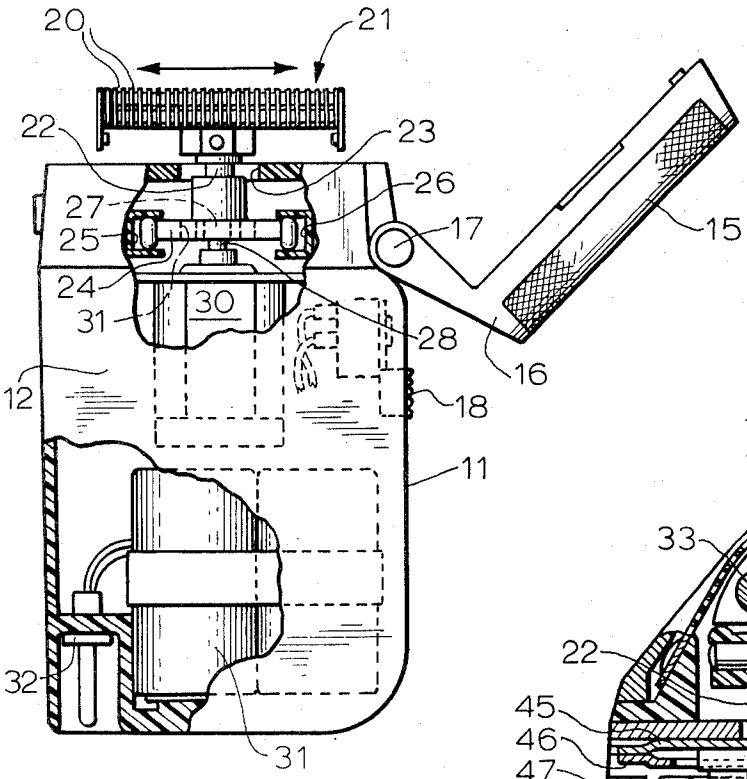



FIG. 2

FIG. 4

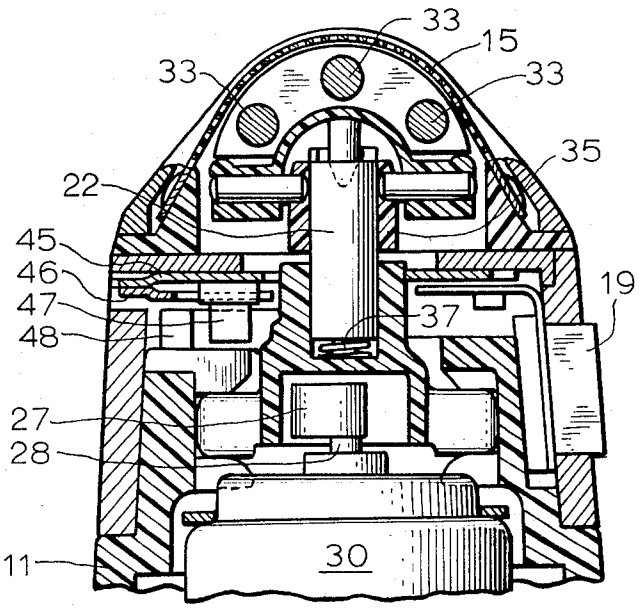


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FIG. 3

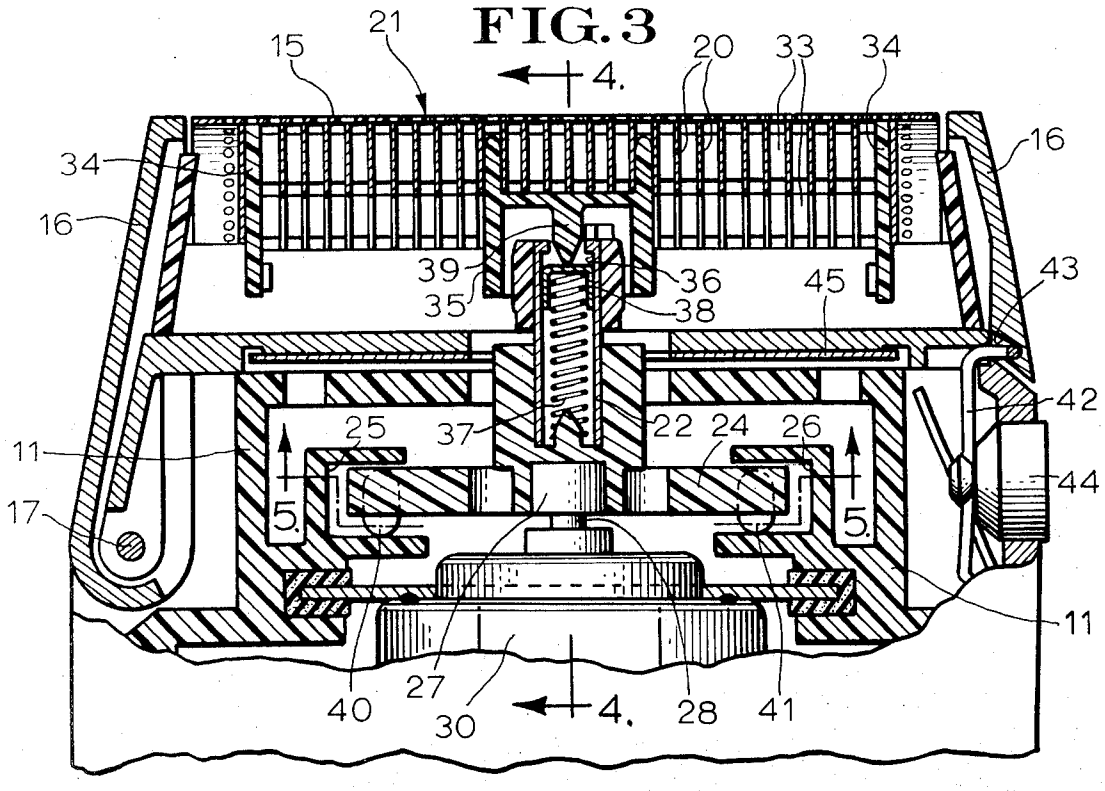



FIG. 5

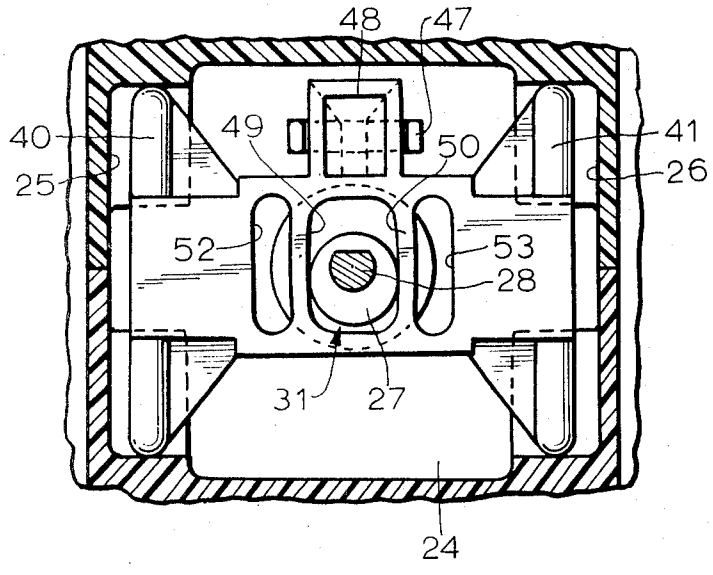
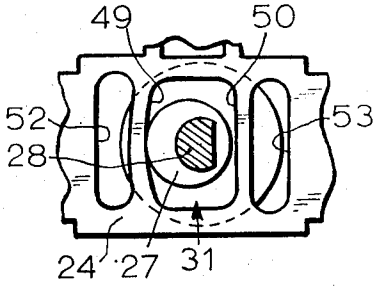



FIG. 7



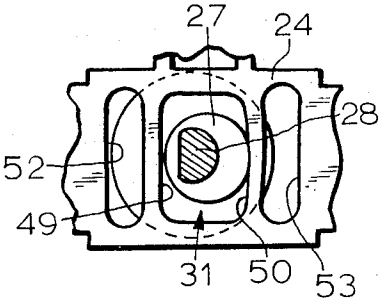




FIG. 8

# DRIVE ASSEMBLY FOR AN ELECTRIC SHAVER

## BACKGROUND OF THE INVENTION

The present invention relates to electric shavers, and more particularly, to an improved drive assembly for the cutting blades thereof.

The cutter head assembly of electric shavers of the reciprocating type generally consists of a stationary comb, and a plurality of reciprocatively driven cutter blades pressed against the inside surface of the comb to achieve a shearing action. A plurality of openings in the comb allow individual hairs to extend into contact with the cutter blades, wherein the hairs are cut by the shearing action of the cutter blades as they reciprocate in contact with the comb.

The cutter blades of an electric shaver are typically mounted in parallel spaced-apart relationship to an underlying framework to form a unitary cutter blade assembly. This assembly is mechanically coupled to an actuator member slidably mounted within the shaver housing. In operation the actuator member is reciprocatively driven by a rotary motor fitted with an eccentric drive cam, the drive cam engaging a slot on the actuator so that as the motor turns the actuator and the cutter blades are caused to reciprocate.

One problem frequently encountered with thus reciprocatively driving the cutter blades is the difficulty of obtaining a suitable coupling between the actuator and the eccentric drive pin. Heretofore, this coupling has been obtained by providing a channel or slot on the actuator member to engage the drive cam. Unfortunately, with time and use the slot or bore tends to become enlarged, resulting in the actuator, and hence the cutter blades, not fully traversing their intended paths. Not only does this reduce the effectiveness of the cutting action, but it also results in an annoying vibration or "hammering" during operation of the razor by reason of the loose fit between the slide and the actuator. This problem may also arise as a result of normal manufacturing tolerances in the diameter of the drive cam and the dimensions of the drive slot, which may at times add up to provide an excessively loose fit, resulting in hammering and reduced efficiency, or at other times may add up to produce an excessively tight fit, introducing undesirable friction and stiffening of the drive assembly.

## SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to provide a new and improved head assembly for an electric shaver.

It is a more specific object of the present invention to provide a new and improved head assembly for an electric shaver which is less susceptible to hammering because of wear-induced variations or production tolerance variations in its drive members.

It is a still more specific object of the present invention to provide a new and improved head assembly for an electric shaver which provides improved cooperation with a motor-driven eccentric in reciprocating the cutter blades of an electric shaver.

It is another more specific object of the present invention to provide a drive assembly for the cutter blades of the electric shaver which is less susceptible to wear and production tolerance variations.



It is another more specific object of the present invention to provide an actuator member for the cutter blades of an electric shaver which provides an improved resilient engagement with the eccentric of a motor-driven drive pin.

The invention is directed, in an electric shaver of the type having a motor and a reciprocatively driven cutter blade assembly, to a drive arrangement for the assembly which comprises a slidably mounted actuator member mechanically coupled to the cutter blade assembly and having an elongated drive recess. Means comprising an eccentric drive cam operatively engaged to the drive recess are provided for reciprocatively driving said actuator member, the drive recess being subject to undesirable size variations having a deleterious effect on the operative engagement of the cam and the drive recess. Means comprising at least one relief recess in the actuator member adjacent the drive recess are further provided for rendering the side walls of the drive recess flexible to compensate for the size variations in the drive recess.

## BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The invention, together with the further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

FIG. **1** is a perspective view of an electric shaver which incorporates a drive arrangement for its cutter head constructed in accordance with the invention.

FIG. **2** is a side elevational view, partially broken away and partially in cross-section, of the electric shaver of FIG. **1**.

FIG. **3** is an enlarged cross-sectional view taken along lines **3—3** of FIG. **1**.

FIG. **4** is a cross-sectional view taken along lines **4—4** of FIG. **3**.

FIG. **5** is an enlarged cross-sectional view taken along lines **5—5** of FIG. **3**.

FIG. **6** is a perspective view of the actuator member shown in FIGS. **2–5**.

FIG. **7** is a top view of a portion of the actuator member shown in FIG. **5** showing the member and its engagement with the eccentric drive cam at one extreme of its travel.

FIG. **8** is a top view of a portion of the actuator member shown in FIG. **5** showing the member and its engagement with the eccentric drive cam at the other extreme of its travel.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Although it will be appreciated that the drive arrangement of the present invention can be fabricated in various shapes and sizes for driving various types of reciprocating members, it finds particular utility in connection with an electric shaver **10** of the type having a reciprocating cutter blade assembly comprising a plurality of upstanding blades urged into contact with a perforated flexible comb, such as the electric shaver shown in FIG. **1**.

Referring now to the figures in greater detail, and particularly to FIGS. **1** and **2**, the electric shaver **10** is

seen to comprise a housing **11** having a generally rectangular body portion **12** and a rounded head portion **14.** The head portion **14** includes a transversely extending work surface or comb **15** which may be fabricated of thin perforated metal or other suitable material. The comb, which is preferably flexible and rounded along its top edge to obtain optimum contact with a skin surface to be shaved, is held in position by a comb frame **16,** which is pivotally mounted at one end to housing **11** by means of a hinge pin **17** or other suitable fastening means. An ON-OFF power switch **18** may be provided at one side of body portion **12** and a control **19** for mechanically extending a longitudinally disposed trimmer blade (not shown in FIGS. **1** and **2**) may be provided along the front face of housing **11.**

In FIG. **2** the comb **15** is shown in its open position, the hinged comb frame **16** being pivoted to an open position to facilitate access to the internal cutting blades **20** of the shaver for cleaning, repair or replacement. The cutter blades are supported in a vertical spaced-apart relationship to form a unitary blade assembly **21,** the latter being removably mounted on a stem **22** which serves to urge the cutting edges of the blades into engagement with the under surface of comb **15** when the comb is in its closed position, and to impart the desired reciprocative motion to the blade assembly during operation of the shaver.

Stem **22** extends through a transversely elongated slot **23** provided in housing **11** and into engagement with a slidably mounted actuator member **24.** A pair of opposed channels **25** and **26** are molded into opposite sides of housing **11** to define a transverse reciprocative path for actuator **24.**

In operation, actuator member **24** is reciprocatively driven along the path defined by channels **25** and **26** by means of an eccentric cam **27** which is carried on the shaft **28** of a motor **30.** The cam is operatively engaged to a drive slot **31** molded into actuator member **24** so that when the cam is rotated by motor **30** the actuator member **24** is forced to reciprocatively slide back and forth. By reason of the coupling provided by stem **22,** this reciprocative motion is transferred to blade assembly **21,** the individual cutter blades **20** contained therein reciprocating against the undersurface of comb **15** for the desired shearing action.

Power for motor **30,** which may be a conventional permanent-magnet type DC motor, is obtained by means of an electrical circuit which may include one or more rechargeable batteries **31,** ON-OFF control switch **18,** and a recessed male connector **32** for establishing a connection to a power cord (not shown) when operating from an AC line or when recharging batteries **31.** The body portion **12** of housing **11,** which may consist of two half-sections joined together, is preferably constructed of an electrically insulated high-impact plastic and may include suitable internal ribbing for supporting the various components of the shaver.

The blade assembly **21** and the drive arrangement therefor are illustrated in greater detail in FIGS. **3** and **4.** Referring to these Figures, the individual cutter blades **20** are held in position by three transversely extending tubular support members **33.** These members are joined at either end to side plates **34** and at their midpoint to a journal block **35.** The cutting blades **20,** support members **33,** side plates **34,** and journal block **35** together comprise the previously mentioned blade assembly **21,** which it will be recalled is removably mounted on stem **22.**

Cutter blade assembly **21** is removably mounted on stem **22** by means of a bore **36** provided on the bottom of journal block **35.** This bore is dimensioned to receive stem **22,** and preferably includes a pair of opposed L-shaped keyways on its inside surface which engage complementarily positioned tab-like key surfaces on stem **22** to achieve a positive locked-rotation engagement between the members. In practice stem **22** may be hollow and a helical compression spring **37** may be provided therein to bias the blade assembly **21** upward, compression spring **37** being provided with an overlying end cap **38** at its top end and journal block **35** being provided with a downwardly extending integral guide pin **39** to engage the end cap. As a result of the upward bias exerted by spring **37** on guide pin **39** and the shape of the keyway on stem **22,** the blade assembly **20** can be removed only after first depressing and then rotating the blade assembly one-quarter turn, which prevents the blade assembly from becoming disengaged during operation of the shaver.

Stem **22** is press-fit into a complementarily dimensioned bore provided on the top surface of actuator member **24.** An annular raised portion may be provided on member **24** for the purpose of extending the depth of this bore, it being desirable to provide a secure engagement between the actuator member and stem **22.** Actuator member **24** is slidably mounted within channels **25** and **26** by means of integral raised runners **40** and **41** molded into actuator member **24** at opposite ends thereof with appropriate spacing and dimensions to fit within channels **25** and **26.** Restoring springs of flat spring steel (not shown) may be provided in a conventional manner on either side of actuator member **24** for smoother operation under varying load conditions.

The comb frame **16,** which it will be recalled is provided to hold the perforated comb **15** in position, is secured to housing **11** at its non-pivoted end by means of a spring clip **42** which engages an appropriately positioned notch **43** provided on the comb frame. Spring **42** bears against a release button **44,** which enables the user to disengage the spring from the comb frame when it is desired to open the frame for cleaning.

Shaver **10** also includes a trimmer blade assembly comprising a pair of flat toothed-edge cutting blades **45** and **46** disposed side-by-side above actuator member **24** and arranged to be extendable from housing **11** for trimming sideburns and the like. In operation the two blades are selectively moved from a retracted or stored position to an extended or working position by user actuation of control **19.** Blade **45** is held stationary and blade **46** is coupled to actuator member **24** by means of an integral drive fork **47** which extends downwardly from the blade into engagement with an appropriately positioned projecting drive arm **48** on actuator member **24.** As actuator member **24** reciprocates, blade **46** is caused to reciprocate and the desired shearing action is obtained between the teeth of the two trimmer blades.

Referring now to FIG. **5,** the drive slot **31** provided in actuator member **24** for receiving the eccentric drive cam **27** is seen to be generally rectangular in form and to have two substantially flat side walls **49** and **50.** The drive cam **27** is dimensioned to simultaneously contact both side walls, exerting a force first against one and then against the other as the drive cam **27** rotates,

which causes the actuator member **24** to reciprocate along the transverse path defined by channels **25** and **26.**

As mentioned previously, with time and use the drive slot **31** provided in actuator member **24** may become enlarged, causing a loose fit to develop between the eccentric cam **27** and the side walls **49** and **50** of the drive slot. Furthermore, normal production tolerances may result in either an excessively loose fit, as when eccentric cam **27** is under-sized and/or drive slot **31** is over-sized, or an excessively tight fit, as when eccentric cam **27** is over-sized and/or drive slot **31** is under-sized. In accordance with the invention, these conditions are precluded by providing one or more additional relief slots or openings adjacent one or more of the side walls of drive slot **31.** The provision of such relief slots in close proximity to the side walls of drive slot **31** causes the side walls to assume an elastic quality whereby dimensional tolerance and wear variations are accommodated by a controlled flexing of the side walls.

Referring to FIG. **5,** in the illustrated embodiment two additional elongated relief slots **52** and **53** are provided adjacent side walls **49** and **50,** respectively. For maximum effectiveness, these relief slots are oriented with their side walls parallel with and in close proximity to the side walls of drive slot **31.** In practice, the width of drive slot **31** is selected to be just slightly smaller than the smallest diameter of cam **27** to insure a uniform hammer-free fit between these elements regardless of normal tolerance variations. The elongated relief slots may extend through the entire thickness of actuator member **24,** as shown in FIG. **6,** or may extend only part way into the thickness of the actuator member as the needs of the particular application dictate.

The effect of the additional drive slots on the reciprocation of actuator member **24** is illustrated by FIGS. **7** and **8.** In FIG. **7** the eccentric drive cam **27** is exerting a force against the left side wall **49** of actuator member **24.** By reason of the close proximity of relief slot **52** side wall **49** flexes to provide a resilient engagement which prevents hammering between the two members and thereby allows the electric shaver to operate more quietly. In FIG. **8** the eccentric cam **27** is exerting a force on the right hand sidewall **50** which, by reason of the adjacent relief slot **53** flexes in the manner of side wall **49.** Thus, during operation of the electric shaver **10** side walls **49** and **50** are cyclically deformed to maintain a continuous uniform engagement between eccentric drive cam **27** and actuator member **24.**

It will be appreciated that other sizes and shapes of slots can be provided in actuator member **24** for accomplishing the same purpose. For instance, the relief slots provided on either side of drive slot **31** can be D-shaped, the flat face of the D extending parallel to the side faces **49** and **50** of drive slot **31.** In either case, the flexibility of the side walls is determined by the spacing between the relief slots and the side walls and the depth of the relief slots, and may be controlled by means of these variables for optimum operating efficiency.

The actuator **24** may be readily fabricated of delrin or other suitable materials by simple conventional molding operations. It will be appreciated that actuator member **24** may assume other sizes and shapes depending on the requirements of a particular application, and that the invention can be practiced in other types of reciprocative appliances. Furthermore, it will be appreciated that various numbers of relief slots can be provided in various shapes, depths and spacings on the actuator member to accommodate particular applications, and that multiple actuator members may be employed with a single motor in those shavers having multiple cutter blade assemblies.

Thus, a novel drive assembly has been shown for the reciprocating-type cutting head of an electric shaver which provides improved durability and resistance against wear, and which provides improved performance in the manufacturing tolerances. The invention is economical in design and construction and requires no additional parts within an appliance, making it particularly adaptable to the highly competitive high-volume reciprocatively driven appliance field.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

We claim:

**1.** In an electric shaver of the type having a motor and a reciprocatively driven cutter blade assembly, a drive arrangement for said assembly comprising, in combination:

a slidably-mounted actuator member mechanically coupled to said cutter blade assembly, said actuator member having an elongated drive recess;

means comprising at least one relief recess in said actuator member adjacent said drive recess for rendering at least one side wall of said drive recess flexible; and

means comprising an eccentric drive cam operatively engaged to said drive recess for reciprocatively driving said actuator member, the diameter of said cam being greater than the width of said drive recess when the side walls of said recess are not flexed to compensate for undesirable size variations in said drive recess.

**2.** An electric shaver as defined in claim **1** wherein said relief recess comprises a slot adjacent the side walls of said drive recess for rendering said side walls flexible.

**3.** An electric shaver as defined in claim **2** wherein said drive recess and said relief recess comprise slots extending through said actuator member.

**4.** In an electric shaver of the type having a motor and a reciprocatively-driven cutter blade assembly, a drive arrangement for said assembly comprising, in combination:

a slidably-mounted actuator member mechanically coupled to said cutter blade assembly and having an elongated drive slot;

means comprising a pair of relief slots in said actuator member adjacent respective sides of said drive slot for rendering the side walls of said drive slot flexible; and

means comprising an eccentric drive cam operatively engaged to said drive slot for reciprocatively driving said actuator member, the diameter of said cam being greater than the width of said drive recess when the side walls of said recess are not flexed to compensate for undesirable size variations in said recess.

5. In an appliance of the type having a motor and a reciprocatively driven working member, a drive arrangement for said working member comprising, in combination:

a slidably-mounted actuator member mechanically coupled to said working member and having an elongated drive recess;

means comprising at least one relief recess in said actuator member adjacent said drive recess for rendering at least one side wall of said drive recess flexible to compensate for said size variations in said drive recess; and

means comprising an eccentric drive cam operatively engaged to said drive recess for reciprocatively driving said actuator member, the diameter of said cam being greater than the width of said drive recess when said side walls are not flexed to compensate for undesirable size variations in said drive recess.

6. An appliance as defined in claim 5 wherein said recesses are slots, and wherein two relief slots are provided on either side of said drive slot for rendering the side walls of said drive slot flexible to compensate for said size variations in said drive slot.

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