

Jan. 8, 1963

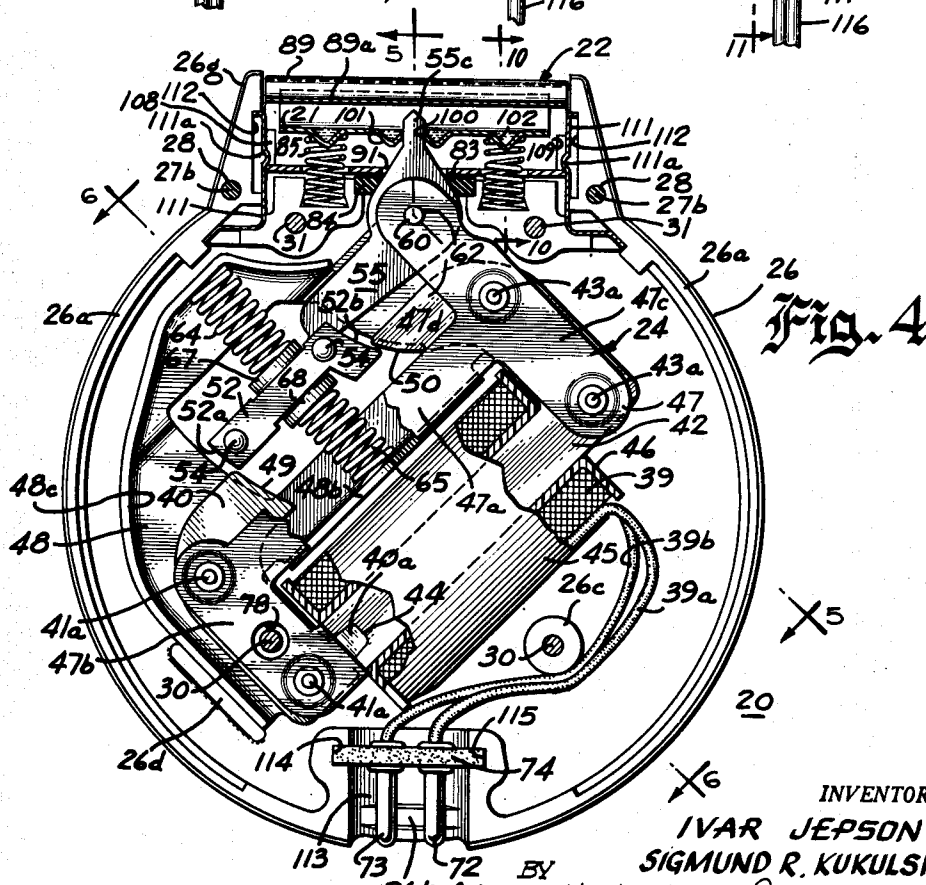
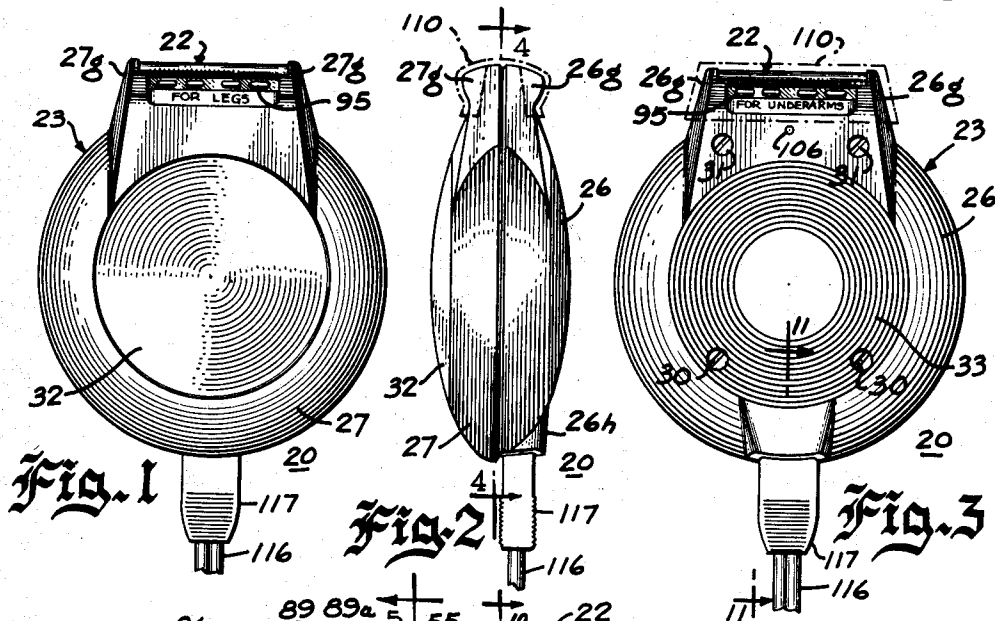
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3,072,809

ELECTRICALLY OPERATED HAIR CLIPPING AND SHAVING DEVICE

Filed Nov. 1, 1955

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

Fig. 5

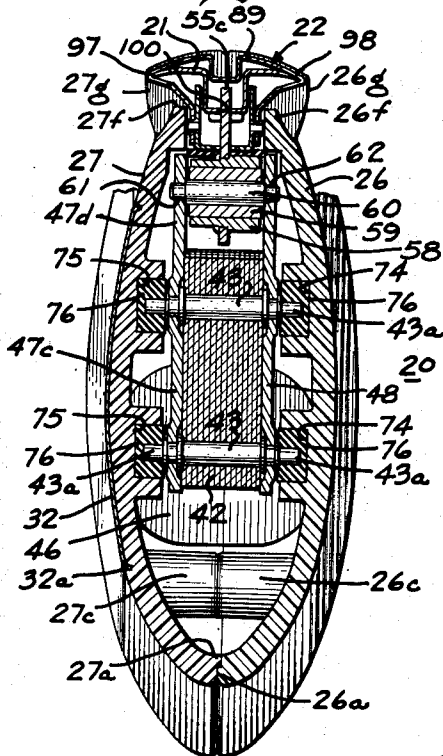


Fig. 6

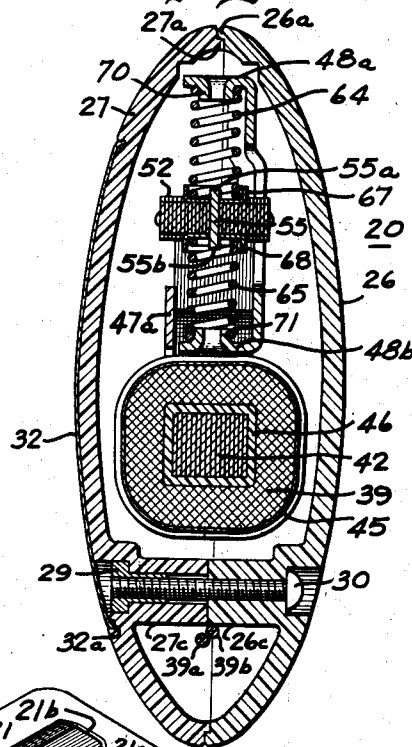


Fig. 7

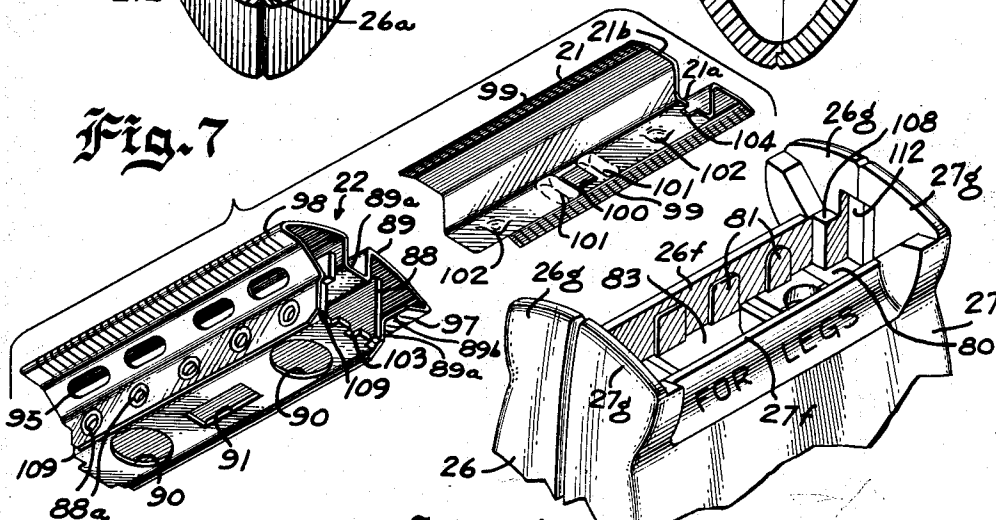


Fig. 8

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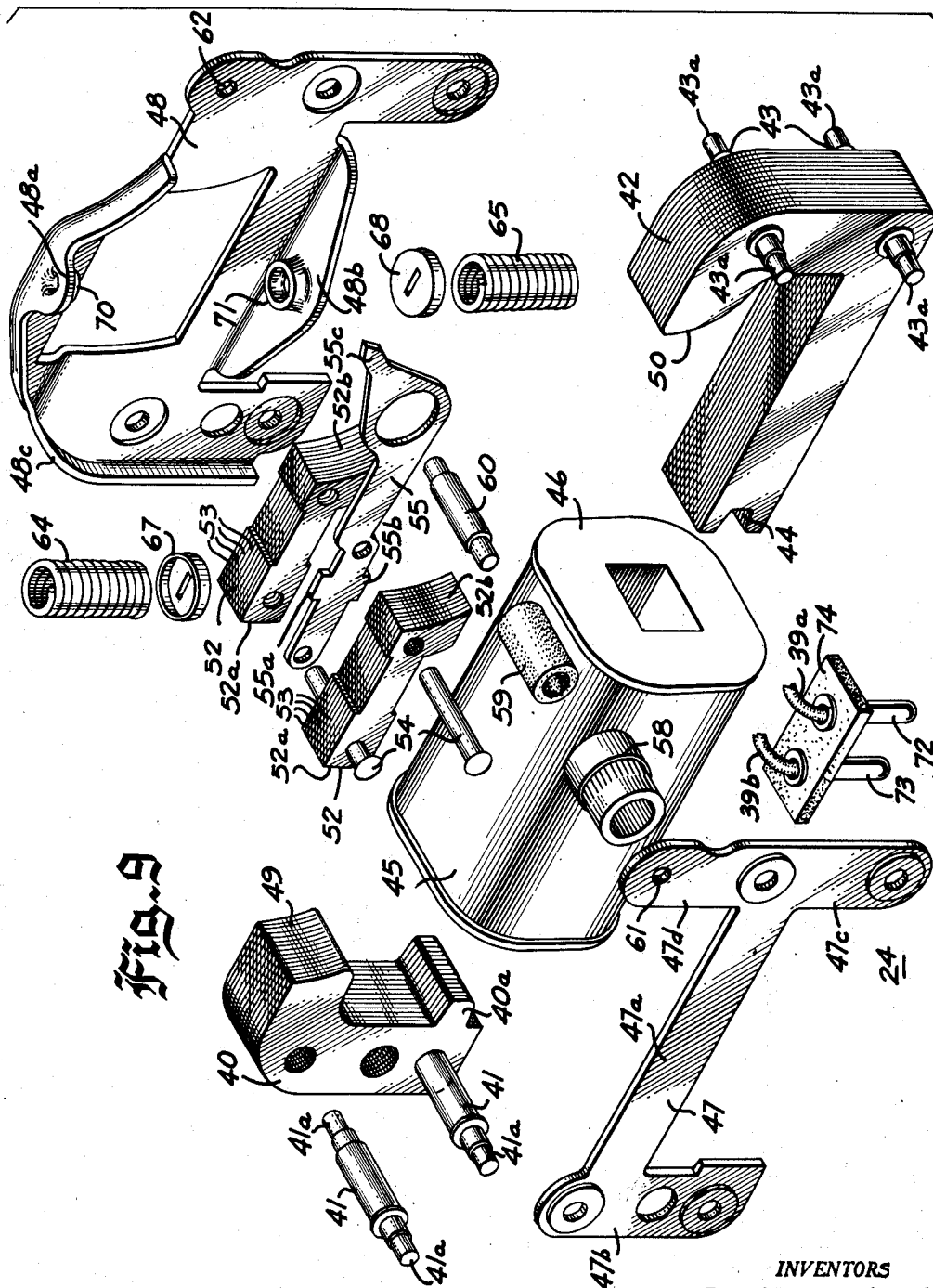


Fig. 9

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4 Sheets-Sheet 4

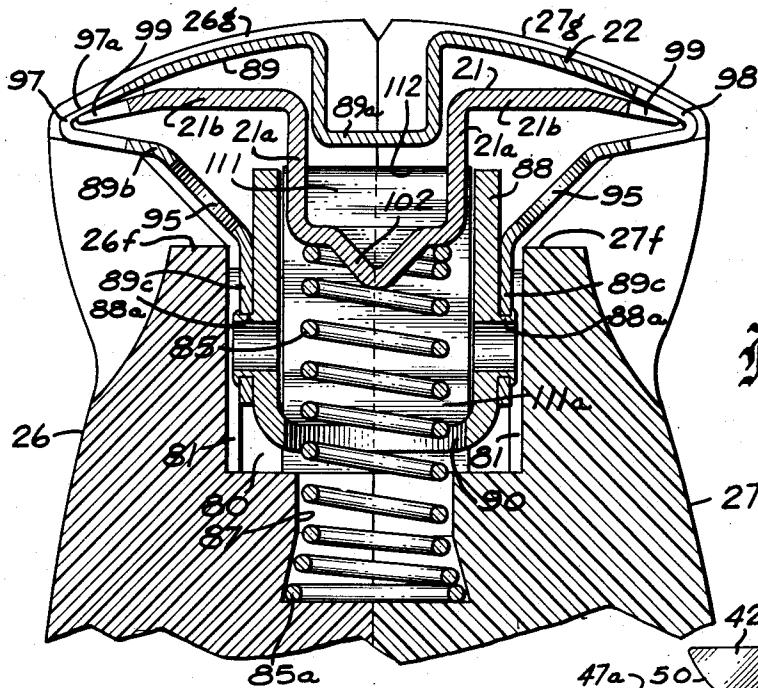


Fig. 10

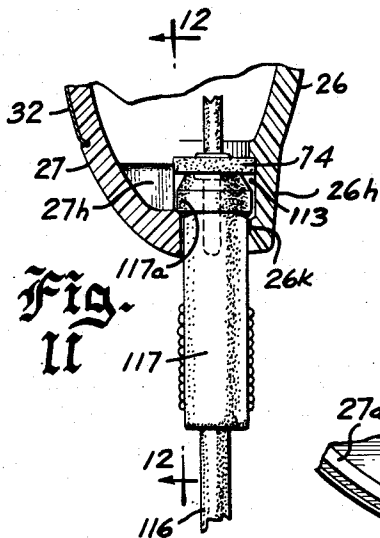


Fig. 11

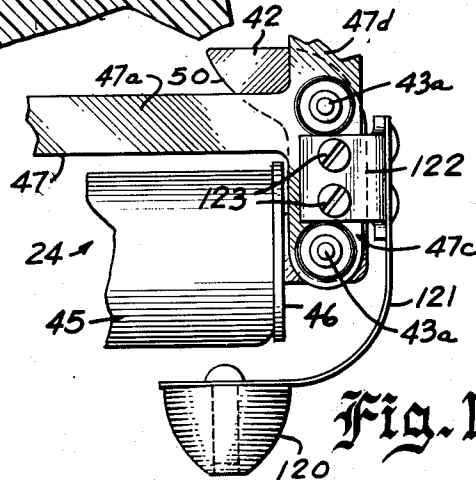


Fig. 12

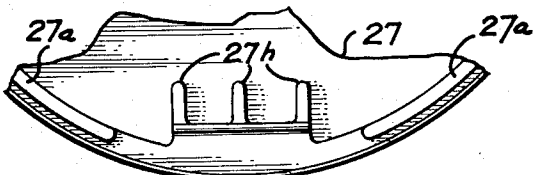


Fig. 13

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ELECTRICALLY OPERATED HAIR CLIPPING AND SHAVING DEVICE

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Filed Nov. 1, 1955, Ser. No. 544,212

10 Claims. (Cl. 310-29)

The present invention relates to an electrically operated hair clipping and shaving device, and, more particularly, to such a device especially designed for the needs of women.

There has long been a definite need by the ladies for a convenient, fast and safe method of removing leg and underarm hair. Manufacturers have sought to capture this market with various devices, among which are emery mits, chemical depilatories, straight razors, safety razors, and, more recently, adaptations of men's electric shavers. All of these methods for removing leg and underarm hair have drawbacks. The various types of blade razors on the market which have been most extensively used cause irritation, and there is always the danger of cutting the skin or nicking the shin bone, which is tender and very slow and difficult to heal. The depilatories are difficult and messy to use, and the emery mit is very unsatisfactory. There have been on the market electric shavers which have been referred to as ladies' shavers, but these have been nothing more than "dressed up" obsolete models of men's electric shavers or adaptations of current models. None of them have been scientifically designed for the job and, hence, have been unsatisfactory.

The problem of removing leg hair and underarm hair is really twofold. The skin on the legs is firm and, therefore, it is possible to shave closely without irritation. The skin under the arms is soft and tender and readily irritated. It would be desirable to provide a hair removing device that will do both these necessary jobs, namely, removing leg hair and underarm hair better than has heretofore been possible.

A hair removing device particularly designed for the needs of women must be a small device, preferably no larger than an ordinary compact, and obviously it must be sturdily built and foolproof in operation. It should preferably be provided with cutting means which are capable of cutting very closely for removing leg hair, and also with cutting means which will remove underarm hair without irritating the soft and tender skin of the underarm.

In order for an electric hair removing device to perform efficiently, it is essential that it be provided with a powerful motor for actuating the cutting means. On the other hand, this powerful motor must be capable of being disposed in a very small, flat case if a satisfactory hair removing device exclusively for the use of women is produced. It would be desirable to provide for such a lady's hair removing device a powerful and yet compact motor which has long life, will give years of trouble-free performance, will require no lubrication, and will produce no radio or television interference.

Accordingly, it is an object of the present invention to provide a new and improved hair removing device designed especially for women which has the desirable features set forth above.

It is another object of the present invention to provide an electric hair removing device having improved cutting means capable of cutting leg hair very close to the skin and at the same time capable of being used to remove underarm hair without irritation.

It is another object of the present invention to provide an electrically operated hair removing device of a size and shape similar to a lady's compact.

It is a further object of the present invention to provide

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a new and improved electric motor for an electric hair removing device which is of small and compact design, light in weight and capable of giving many years of trouble-free performance.

Still another object of the present invention resides in an improved electric motor which has no commutator, vibrating contacts or the like, so that no problem of television or radio interference is involved.

It is another object of the present invention to provide an improved electric hair removing device in which improved means are provided for preventing the power cord from becoming disconnected from the device.

It is another object of the present invention to provide an electrically actuated hair removing device especially designed for women, having a readily removable cutting mechanism which can be cleaned and replaced in a very simple manner.

Still another object of the present invention is to provide in a hair removing device designed particularly for women a cutting mechanism which can only be attached to the motive means in a particular manner thereby insuring proper use thereof.

Further objects and advantages of the present invention will become apparent as the following description proceeds, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the present invention, reference may be had to the accompanying drawings in which:

FIG. 1 is a top plan view of an electrical hair removing device embodying the present invention;

FIG. 2 is a side elevational view of the arrangement disclosed in FIG. 1, but with a comb guard shown in attached position;

FIG. 3 is a bottom plan view similar to FIG. 1, but also showing a comb guard as in FIG. 2;

FIG. 4 is an enlarged sectional view taken on line 4-4 of FIG. 2, but without the comb guard;

FIG. 5 is a sectional view taken on line 5-5 of FIG. 4, assuming that FIG. 4 shows the complete structure;

FIG. 6 is a sectional view taken on line 6-6 of FIG. 4, again assuming that FIG. 4 shows the complete structure;

FIG. 7 is an exploded perspective view of the comb assembly and cutter only of the hair removing device of the present invention;

FIG. 8 is a perspective view of the portion of the casing of the hair removing device of the present invention to which the comb and cutter are adapted to be attached;

FIG. 9 is an exploded perspective view of the motor of the electric hair removing device of the present invention;

FIG. 10 is a greatly enlarged sectional view taken on line 10-10 of FIG. 4, assuming that FIG. 4 shows the complete structure;

FIG. 11 is an enlarged fragmentary view of a portion of the electric hair removing device of the present invention taken along line 11-11 of FIG. 3;

FIG. 12 is a sectional view taken on line 12-12 of FIG. 11, assuming that FIG. 11 shows the complete structure; and

FIG. 13 is a fragmentary view of a portion of the electric motor illustrating a modification of the present invention.

Briefly, the present invention is concerned with a lady's electric hair removing device particularly designed for removing both underarm and leg hair, which has a plastic case of pleasing appearance of a shape and configuration very similar to that of a lady's compact. A powerful and efficient resonant motor, having no contacts, brushes or the like, is adapted to be disposed within the casing to actuate a cutter. A comb and cutter assembly is mounted for ready removal from one edge of the cas-

ing, and the cutter is adapted to be driven by the electric motor to oscillate at a speed of the order of more than 14,000 cutting strokes per minute. The comb and cutter assembly is provided at one edge with means for cutting leg hair and is capable of cutting very close to the skin. On the other edge it is provided with means for removing underarm hair, designed so as not to cut too closely, thereby avoiding underarm irritation. The motor is mounted in the casing in a manner to be substantially vibration-free, and the entire mechanism is very light in weight, compact in design, capable of giving years of trouble-free performance.

Referring now to the drawings, there is illustrated an electric hair removing device, generally designated by the reference numeral 20. Essentially, this electric hair removing device comprises a reciprocating cutting blade or cutter 21, operating in coaction with a suitable comb assembly generally indicated at 22. The comb assembly and cutter are suitably and removably mounted on a casing 23. A powerful electric motor, generally designated at 24, is housed within the casing 23 and drivingly connected to reciprocate the cutter 21.

Since the electric hair removing device 20 has been especially designed to meet the needs of women, the casing 23 is preferably of a flat, circular configuration, best shown in FIGS. 1 to 3 of the drawings, so as to have a size and appearance very similar to that of the conventional compact. By conventional compact is meant the generally circular relatively thin container commonly used as a compact. In a successful device built in accordance with the present invention the casing 23 was slightly under three inches in diameter and of the order of an inch in maximum thickness. As illustrated, the casing 23 is a two-part casing, comprising the cooperating parts 26 and 27, preferably molded from a suitable plastic. It will be appreciated that many moldable plastic materials are readily available on the market which provide a smooth and desirable appearing surface of any color. It will be understood that such an electric hair removing device particularly designed for women will have casings of different colors to fit in with particular color schemes and the like. Essentially, the two casing sections 26 and 27 are very similar, although not identical, the interior of each being essentially a mirror image of the other. In order to insure that the casing sections 26 and 27 may be held together in a predetermined relationship, the casing section 26 is provided over a substantial portion of its periphery engageable with the casing section 27 with an annular ledge 26a which cooperates with a similar ledge 27a provided around a substantial portion of the periphery of the engaging face of casing section 27 (see FIGS. 4, 5, 6 and 12). The annular ledge 26a is displaced slightly laterally in casing section 26 relative to annular ledge 27a, so that when the casing sections are in the position shown in FIGS. 5 and 6, these ledges are side by side and a smooth exterior is provided at the junctions of the casing sections 26 and 27. To further insure proper orientation of the casing sections, the section 27 is provided with integral pin portions 27b receivable in suitable cooperating openings 28 defined in casing section 26. These are best shown in FIG. 4 of the drawings.

In order to hold the casing sections 26 and 27 together to form casing 23 to house the motor 24 therein, the casing section 27 has provided therein a plurality of threaded inserts such as 29 for threadedly receiving suitable fastening means such as 30 to clamp the casing sections together. As best shown in FIG. 4 of the drawings, four screws or fastening means are provided, two of them being designated as 30, and the other two being designated as 31. Preferably, the fastening means 31 engage threaded inserts which are molded into the casing in a well known manner, and which threaded inserts are not shown in the drawings. The fastening means 30, on the other hand, as is best shown in FIG. 6 of the draw-

ings, engage threaded inserts 29 which need not be molded into the casing, but which may be inserted into openings defined in casing section 27. The threaded inserts 29 are preferably each provided with an enlarged head portion, so that it will serve effectively as a nut threadedly to receive the fastening means 30 to clamp the casing sections together.

To give strength to the casing sections 26 and 27 and to insure that the plastic walls thereof cannot be crushed together, each of the casing sections 26 and 27 is provided with a strut, designated as 26c and 27c, respectively, which struts have aligned openings to receive one of the fastening means 30, and the adjacent ends of which struts abut each other to limit the distortion of the casing when the fastening means 30 is threadedly engaged with the threaded insert 29 effectively serving as a nut. Comparable projections 26d and 27d are provided to abut each other on the opposite side of the casing from the struts 26c and 27c, one of the projections, namely, 26d being shown in FIG. 4 of the drawings. The projections such as 26d, illustrated as long and slender, are provided in order to take up a minimum space and to permit the maximum space within the casing to be available for positioning the motor 24.

To provide a pleasing exterior for the casing 23, the top or bottom or both of the casing may be provided with a suitable metal plate such as 32, which may have any type of design thereon including initials, a monogram or the like. As illustrated in FIGS. 5 and 6 of the drawings, this plate 32 is provided and a peripheral flange 32a which is disposed in a circular recess defined in the casing section 27. Preferably, a plurality of tabs, not shown, integral with the plate 32 extend through openings in the casing section 27 and are peened over to hold the plate 32 in position. As is best shown in FIG. 6 of the drawings, the plate 32, in addition to being a decorative plate, also hides the threaded inserts 29, so that a very pleasing casing appearance is provided. Such a plate may also be provided on the outside of the casing section 26, although, as illustrated, a suitable design indicated at 33 is molded directly into the plastic of the casing. The screws 30 and 31 are available from this side of casing, as is clearly shown in FIG. 3 of the drawings.

Before considering other specific details of the casing 23 for housing the motor 24, the details of the motor construction shall first be considered. It will be apparent that to provide a proper hair cutting operation a powerful motor is desirable. It is also appreciated that with the casing construction illustrated, of the size and shape of a compact, any usable motor will have to be very compact. In accordance with the present invention, the motor 24 is a very simple, compact motor, with no brushes or contacts which could cause radio and television interference. As illustrated, the motor 24 is a powerful resonant motor, best shown in FIGS. 4 and 9 of the drawings. This motor comprises a field structure which is a two-part field structure comprising somewhat U-shaped laminations 40 held together by suitable rivets such as 41. The other portion of the field structure comprises somewhat L-shaped laminations 42 held together by rivets 43. The laminations 42 are provided at one end with cooperating notches 44 to receive tongues 40a integral with the laminations 40. The field structure is designed in two parts to facilitate assembling thereon a field coil designated as 45. The assembled position of the field structure and field coil is clearly shown in FIG. 4 of the drawings. Preferably, the field coil comprises the conventional spool 46 with the necessary end portions, between which end portions and on which spool the winding 39 is wound in the conventional manner. The ends of winding 39 define current conductors 39a and 39b.

For the purpose of holding the field structure comprising the laminations 40 and 42 and the coil 45 in assembled relationship, there is provided a motor field plate

47 and a frame plate 48. The motor field plate 47 of somewhat T shape comprises an elongated central member 47a with integral transverse end members 47b and 47c, the transverse end member 47c having a portion 47d extending on the opposite side of the portion 47a, as is clearly shown in FIG. 9 of the drawings. The frame plate 48 is more complicated but includes portions corresponding to the above-described portions of plate 47. The assembled field laminations 40 and 42 are clamped between the elements 47 and 48 which have cooperating openings for the rivets 41 and 43. In accordance with the present invention, these rivets have projections which extend from either side of the field structure for a purpose which will be described in greater detail hereinafter. As illustrated, the projections on the rivets 43 are designated as 43a, and the projections on the rivets 41 are designated as 41a. Suffice it to say that in addition to providing the projections 41a and 43a, the rivets hold the field structure including the field plate 47 and frame 48 in assembled relationship. Preferably, the members 47 and 48 are formed of nonmagnetic material, such as brass, so as not to provide a flux path for the flux in the laminations 40 and 42, which, of course, are formed of magnetic material, such as silicon steel or the like. The assembled field structure and winding provides an air gap between pole faces 49 and 50 which are defined on corresponding portions of the field laminations 40 and 42. The plates 47 and 48 insure that the air gap between the pole faces 49 and 50 is properly maintained.

In accordance with the present invention there is provided an armature 52 which is formed of a plurality of laminations 53 held in assembled relationship by rivets 54. To support the armature 52 for pivotal movement, there is provided a bell crank 55, one arm of which is preferably disposed at the center of the armature between two equal sections of laminations 53. The rivets 54 hold the laminations 53 and bell crank 55 in assembled relationship. To provide a driving member for transmitting power to a suitable driven member, the bell crank 55 is provided with an arm or projection 55c through which power from the motor 24 is transmitted to any suitable means to be driven thereby. It will be appreciated that the armature 52 is designed to move within the air gap between pole faces 49 and 50, and to this end is provided with cooperating pole faces 52a and 52b. For the purpose of supporting the armature 52 for movement between the pole faces 49 and 50, the bell crank 55 is pivotally supported about a pivot point located outside the field structure. As illustrated, the bell crank 55 is secured to a suitable bushing 58 having a suitable bearing therein, designated as 59, which may be a porous bronze bearing or the like. The bell crank 55 and associated bushing 58 and bearing 59 are pivoted about a suitable shaft such as 60 extending between the frame members 47 and 48. As illustrated, the shaft 60 extends between the projection 47d of frame 47 and a corresponding projection on frame 48. Openings 61 and 62 in frame members 47 and 48 accommodate the shaft 60. With this arrangement, the armature 52 is caused to describe an arcuate path about the pivot member or shaft 60, and by virtue of the bearing 59 this movement is constrained to insure arcuate movement of the armature 52 within a fixed path.

The armature 52 is substantially L-shaped, with the base of the L being the end portion 52b which is disposed nearest the pivot shaft 60. The longitudinal axis of said armature extends through the long arm of the L and generally perpendicular to the base thereof, and is generally parallel to the longitudinal axis of the air gap defined by a line extending between pole faces 49 and 50. It will be apparent that the base of the L thus provides a greater cross-sectional area for the end of the armature closest the pivot pin which moves through a smaller arc than does the end 52a thereof. In order to provide a normal or rest position for the armature 52,

there are provided a pair of armature springs 64 and 65 which normally tend to bias the armature to the predetermined position shown in FIG. 4 of the drawings, so that the armature is disposed almost outside the gap between pole faces 49 and 50. Upon energization of the winding 45, it will be apparent that the armature 52 will be attracted to tend to move in a direction to cause the pole faces 52a and 49 to be in substantial alignment, and similarly to cause the pole faces 52b and 50 to be in substantial alignment. In the normal or at rest position of the armature, as shown in FIG. 4 of the drawings, the end 52b is partially in registry with the pole face 50 so as to provide a flux path with a sufficiently low initial reluctance to insure that the armature 52 be pulled into the air gap when current is supplied to winding 39. It will be appreciated that with this construction the reluctance of the flux path at the end 52b of the armature is reduced thus insuring a higher flux density in the air gap adjacent pole face 49. This higher flux density produces a greater force at that end 52a of armature 52 which has the maximum moment arm about the pivot pin 60. Thus this greater force insures a greater torque causing pivotal movement of armature 52. This more than offsets any decrease in force by virtue of the decrease in reluctance of the flux path at the end 52b of armature 52.

To provide the most compact motor it is apparent that the armature 52 must have a minimum dimension in the direction of the longitudinal axes of the springs 64 and 65, since these springs must have a minimum length for satisfactory operation. However, the armature 52 should have a predetermined mass and moreover its area of cross-section should be such to provide a low reluctance path. To this end the armature 52, as best shown in FIGS. 6 and 9 of the drawings, is relatively wide and substantially wider than the thickness of the field structure. Thus a low reluctance path is provided even while maintaining the dimension of the armature in the direction of the longitudinal axes of the springs 64 and 65 very small.

In order to support the springs 64 and 65 in a manner to hold the armature in its neutral position and tend to return it to that position, the portion of bell crank 55 clamped between laminations 53 defining armature 52 is provided on either side thereof with projections 55a and 55b to support spring retaining cups 67 and 68, respectively. These spring retaining cups are secured to the projections 55a and 55b by staking or the like, so that the cup will hold the adjacent ends of the springs 64 and 65, respectively. To support the other ends of the springs, the frame 48 is provided with a pair of ears 48a and 48b, respectively, which project laterally from the frame proper so as to be disposed on either side of the cups 67 and 68, respectively. These projections 48a and 48b are provided with integral cylindrical bosses 70 and 71 to be received within the coiled springs 64 and 65, respectively. For the sake of rigidity, the frame 48 preferably is provided with a peripheral flange 48c which includes as an enlargement thereof the projection 48a. It will be apparent that the frame 48 effectively performs a threefold operation: it acts as the motor frame, it provides a pivot support for the armature 52, and it also provides a support for the springs 64 and 65. Preferably, the springs 64 and 65 are precision coil springs accurately calibrated to be resonant at a frequency slightly separated from the frequency of the energization circuit for the winding 39. Where the power source is a sixty-cycle alternating current source and the motor operates at double frequency, the springs 64 and 65 are preferably calibrated at just about sixty cycles or a harmonic thereof. Obviously, if they were resonant exactly at sixty cycles, one hundred twenty cycles or the like, the amplitude of the armature might be too great. On the other hand, if they were tuned to resonance too far away from sixty cycles, one hundred twenty cycles or the

like, too much power would be lost. In a device built in accordance with the present invention, the springs 64 and 65 were tuned to resonance between sixty-three cycles and sixty-seven cycles. As was pointed out above, the armature 52 is illustrated in the drawings as being wider than the field structure, to provide the maximum weight of the armature in a small size motor while permitting the maximum length of the springs 64 and 65. Moreover, for most satisfactory operation of the motor 24, it is desirable to provide an arrangement whereby the maximum rate of change of flux occurs upon armature movement. By pivoting the armature 52 from a point outside the field structure, with the armature moving radially into the air gap in the field structure, this is accomplished.

As shown in FIGS. 4 and 9 of the drawings, the ends 39a and 39b of the winding 39 of coil 45 are connected to suitable terminal pins 72 and 73, which are adapted to cooperate with a more or less conventional female type terminal plug described hereinafter. To hold the terminal pins 72 and 73 in spaced parallel alignment, a suitable terminal board 74, formed of an insulated material such as a laminated phenolic, is provided, the terminal pins 72 and 73 being suitably secured thereto and electrically connected to the ends 39a and 39b, respectively, of the winding 39 defining the coil 45 in a manner well understood by those skilled in the art.

It will be apparent from the above description that the motor 24 is a unitary assembly which is very small and very compact. Upon energization of the field coil 45 with alternating current, the armature 52 will be attracted into the air gap as the alternating flux produced thereby builds up toward the positive or negative peak. As this alternating flux goes through zero, the magnetic forces acting on armature 52 also go through zero and the springs 64 and 65 tend to return the armature to its normal or zero position. During the other half cycle of the alternating current flux the process will be repeated. It will be apparent, therefore, that the oscillations of the armature 52 will be twice the frequency of the alternating current supplied to winding 39, and as long as power is supplied to winding 39, the armature 52 will oscillate about pivot shaft 60 at double the frequency of the supply voltage. Moreover, this motor will produce no clattering noise or the like, which is the case with vibrating type motors, as the armature moves against the field structure, since it is impossible for the armature 52 to make physical contact with any part of the field structure, the springs 64 and 65 effectively suspending the armature for oscillation about pivot shaft 60. Thus, even excessive movement of the armature 52 will cause no engagement with the field structure whatever. It will be appreciated that with a sixty-cycle power source, the armature will have a one hundred twenty cycle frequency, which means 14,400 strokes per minute to be transmitted to the movable cutter described hereinafter by the arm 55c of bell crank 55.

In accordance with the present invention, the projections 41a and 43a of the rivets 41 and 43, respectively, of motor 24 are used to position and secure the motor 24 within the casing 23. To this end each casing section 26 and 27 is provided with four recesses, only two of which are shown for each casing section in FIG. 5 of the drawings. These recesses are designated by the reference numeral 74 for the casing section 26, and 75 for the casing section 27. Supported within each recess 74 and 75 is a rubber mounting member 76, eight of them being provided in all. These rubber mounting members have a central opening adapted to receive the projections 41a and 43a of the rivets 41 and 43, respectively. Thus, when the motor 24 is disposed within the casing 26, it is suitably supported in rubber mountings, whereby the transmission of vibrations from the motor to the casing is substantially reduced. The recesses 74 and 75 are so disposed that the driving arm 55c of the bell crank 55, whose other arm supports the armature 52, is on one side

of the casing 23, and diametrically opposed are the terminal pins 72 and 73.

In order to accommodate one of the fastening means 30, the motor, and specifically the laminations 40 and the frame portions 47 and 48 are provided with aligned openings to define a passageway 78 through which this fastening means may extend. However, the fastening means 30 passing through these aligned openings does not hold the motor 24 in position other than indirectly by clamping the casing sections together. Preferably, the passageway 78 is of larger diameter than the fastening means 30 so that vibrations of the motor 24 are not transmitted directly to the casing 23 through the fastening means 30. The only reason the fastening means 30 passes through the field structure is a matter of convenience, since the motor takes up such a large portion of the casing 23 that it is difficult to include therein a fastening means which does not pass through some portion of the motor. The motor itself is maintained in position solely by the projections of the rivets 41 and 43 and the rubber mounting members 76 disposed in the recesses 74 and 75. With the motor in position in one of the casing halves such as 26 or 27, the other casing section can then be moved into position in a very simple manner and the fastening means 30 and 31 employed to clamp the casing sections together thereby firmly to support in vibration-free manner the motor 24 within the casing 23. It will be appreciated that the rubber mountings 74 and 75 will also prevent the excessive tightening of the fastening means 30 and 31. With the above described arrangement the motor 24 is readily removable for service and repair.

In order to support the comb assembly 22 and associated cutter 21, the casing 23, which has been described as a generally circular, flat casing, much on the order of a conventional lady's compact, is provided at the edge thereof, and specifically at the edge defined by the junction of the two casing sections 26 and 27, with an integral projection which might be designated as the cutting head section of the casing. As illustrated, the casing section 26 is provided at the edge thereof over a small portion of the periphery with a projection 26f and two transverse projections 26g disposed at the end of projection 26f. Similarly, the casing section 27 is provided with a projection 27f and two transverse projections 27g disposed at the end of projection 27f. These projections, when the casing is assembled, define therebetween a recess 80, best shown in FIG. 8 of the drawings, for receiving the comb assembly 22 and cutter 21 in a manner to be described hereinafter. The casing sections 26 and 27 are designed so that when assembled they define the recess 80. The bottom of this recess, as viewed in FIG. 8 of the drawings, is defined by casing walls to provide a substantially closed casing. Moreover, when the cutter 21 and comb assembly 22 are disposed in recess 80, the portion of the comb assembly defining the skin engaging portion is preferably substantially level with the ends of the projections 26g and 27g, as shown in FIGS. 4, 5 and 10 of the drawings. For a purpose which will become apparent from the following description the walls of recess 80 are provided with spaced ribs 81 defining grooves therebetween.

In order that the actuating arm 55c of bell crank 55 oscillated by the armature 52 may project into recess 80, an opening 83 is defined in cooperating wall sections of the casing forming the substantially closed bottom of recess 80 through which the arm 55c may extend. To prevent hair, hair clippings and foreign matter from entering the opening 83, and hence from entering the motor chamber within casing 23, there is provided a resilient sealing member 84, which may be in the form of a sponge rubberlike member which has an opening through which the actuating arm 55c of bell crank 55 extends. The sponge sealing member 84 fits tightly around the actuating arm 55c to insure a sealing action

and at the same time effectively closes the opening 83 without interfering with oscillating movement of actuating arm 55c.

It will be appreciated that in any cutting device where a reciprocating cutter moves relative to a comb to perform a hair shearing or cutting operation, means must be provided to bias the cutter into shearing engagement with the comb. In accordance with the present invention, coiled springs 85 are provided for this purpose. These springs preferably have an enlarged turn or two at one end thereof, designated in the drawings as 85a (see FIG. 10). These springs are arranged to be contained in openings 87 defined in the cooperating portions of the casing sections 26 and 27 immediately below recess 80, which abut each other when the casing sections are clamped together as clearly shown in the drawings. These recesses 87 are effectively undercut (see FIG. 10) so that when the springs 85 are inserted therein during the time when the casing sections are clamped together, the enlarged turns 85a prevent their subsequent removal. Thus, the springs 85 project into the recess 80 for ready engagement with the cutter to be described hereinafter and are held in the operative position shown in FIGS. 4 and 10 of the drawings by the shape of the walls defining recesses 87.

The comb assembly 22, which cooperates with casing 23 to define a cutting head, is illustrated as a two-part member including a U-shaped support 88 and a comb portion 89, the latter being preferably made of sheet metal and having a hollow mushroom-shaped head providing a generally rectangular, arcuate face for contacting the skin from which the hair is to be removed. For the purpose of providing strength and rigidity in the arcuate portion of the mushroom-shaped cutter 89, there is provided a central rib 89a which, as is best shown in FIG. 10 of the drawings, is a channel-shaped deformation formed at the center of the arcuate portion. Essentially, the mushroom-shaped comb portion 89 of the comb assembly 22 includes, in addition to the arcuate section thereof having the central rib 89a, a pair of converging side portions 89b which connect spaced parallel portions 89c to the arcuate portion. The converging portions 89b are provided with a plurality of openings 95 along the length thereof, which are effectively hair escape openings through which hair clippings may fall. As is clearly evident from FIG. 10 of the drawings, the upwardly directed ends of the U-shaped support 88 extend to a point adjacent the bottom of the cutter 21 and serve to deflect clipped hair out through the openings 95, hence effectively preventing such hair from entering the inner portions of the comb and cutter assembly. Preferably, both the comb portion 89 and the U-shaped support 88 have a length of the order of the spacing between the projections 26g and 27g. The U-shaped support 88 has a width so as to be disposed between the spaced parallel portions 89c of the comb 89 and is provided along each side thereof with outwardly directed hollow projections 88a by means of which the mushroom-shaped comb portion 89 of the cutting head may be secured thereto. As illustrated, the portions 89c are provided with a plurality of aligned openings on either side for receiving the projections 88a, which projections may then be deformed as shown in FIGS. 7 and 10 of the drawings effectively to secure the U-shaped support 88 to the comb portion 89. Actually, the U-shaped support 88 may be formed from a relatively heavy material to provide a strong support. Moreover, this U-shaped portion 88 of the comb assembly is designed to fit snugly within recess 80. The rivet portions 88a are accommodated within the spaced grooves defined between the ribs 81.

In order that the springs 85 may properly engage the cutter 21 whenever the comb and cutter assembly is attached in operative relationship to casing 23, the bight portion of the U-shaped support 88 is provided with a

pair of relatively large openings 90 through which springs 85 may extend without interference. Also, the bight portion of the U-shaped support 88 is provided with a central elongated opening 91 to permit the actuating arm 55c of the bell crank 55 to move freely and without interference when in driving engagement with the cutter, as will be described in greater detail hereinafter. For purposes which will become apparent from the following description, the mushroom-shaped comb portion 89 is formed of relatively thin spring steel material, preferably having a thickness of the order of twelve-thousandths of an inch or preferably between ten- and fifteen-thousandths of an inch. In order to prevent underarm irritation, it is essential that the hair removing operation does not result in cutting too closely, and the range of thickness set forth above is necessary, as will become apparent from the following description, to avoid cutting too closely.

In accordance with the present invention, the comb portion 89 is provided with two sets of teeth, one along either edge of the arcuate portion, which teeth are designated as 97 and 98, respectively. These teeth are formed by providing a plurality of slots along each edge of the comb through both the arcuate portion and the diverging portions thereof, which, by virtue of the mushroom shape, are closely adjacent, as is clearly evident from FIG. 10 of the drawings. If the thickness of the spring steel material from which the comb portion 89 is made is of the order of twelve-thousandths of an inch, the teeth 98 will insure that no closer cutting than twelve-thousandths of an inch will occur. Thus, the teeth 98 effectively provide the teeth for cutting underarm hair. In order that the teeth 97 may insure much closer cutting for removing leg hair, the top edge of the arcuate portion of comb 89 along the teeth 97 is ground very thin, as indicated at 97a in FIG. 10 of the drawings, so that the stock thickness of these teeth 97 may be much thinner than twelve-thousandths of an inch to provide close cutting for the removal of leg hair. In a hair removing device built in accordance with the present invention, the edge of the arcuate comb portion adjacent teeth 97 was ground to a thickness of the order of five-thousandths of an inch and preferably between three- and seven-thousandths.

For the purpose of providing the desired shearing action with comb portion 89, the cutter 21, also formed of spring steel or suitable material which will insure good cutting action, is provided with a central U-shaped channel portion 21a slightly larger than the rib 89a so the latter may be partially nested therein, and a pair of laterally extending flange portions 21b, each of which terminates in cutting teeth 99. The rib 89a serves as a guide for the reciprocating cutter 21 within which the rib 89a is nested. Preferably a loose fit between the channel portion 21a and rib 89a is provided so that even and distributed wear will occur between the comb and cutter teeth. The cutting teeth 99 are adapted to be disposed immediately beneath the cutting teeth 97 and 98, as is clearly shown in FIG. 10 of the drawings. Preferably, the cutter is ground on a cylindrical radius slightly larger than the radius of the comb at the teeth portions 97 and 98 thereof, so that the cutter will lap into the comb with use thereof to insure very good shearing action.

In order to drive the cutter from arm 55c or bell crank 55, an opening 100 is preferably defined at the center of the bight portion of section 21a of cutter 21. Preferably also, a distortion 101 of the bight portion 21a is provided on either side of this opening to insure engagement with the actuating arm 55c which is adapted to extend into the opening 100, as is clearly shown in FIG. 5 of the drawings. Also to insure proper engagement of the springs 85 with the cutter, the bight portion of the U-shaped section 21a thereof is provided with a plurality of dimples 102, which are adapted to be received into the upper ends of the springs 85, as is clearly shown in FIG. 10 of the drawings. Thus, when the comb and cutter assembly is moved

into the position shown in FIG. 10 of the drawings, the actuating arm 55c moves into driving engagement with the cutter 21, and the springs 85 move into engagement with the U-shaped portion 21a of the cutter 21, the dimples 102 insuring proper positioning of the springs 85 relative to the cutter 21. It will be apparent that there has been provided a cutting head which has two cutting edges, one edge for underarm hair which is adapted not to cut too close, and another edge for leg hair which is capable of cutting very closely.

It will be appreciated that, since the cutter 21 is lapped into the comb, it is important that the cutter is always assembled with the comb in the same predetermined manner, otherwise the lapping operation will be of little value. Accordingly, the comb and cutter are preferably provided with means to insure assembly in the same manner. In an embodiment built in accordance with the present invention, one side of the cutter and the corresponding side of the comb were painted or otherwise coated with the same unique color, so that in assembling the same the operator could readily make sure that the corresponding colors were on adjacent sides. Additionally, as shown in FIG. 7 of the drawings, the corresponding ends of the comb assembly 22 and cutter 21 may be provided with distinctive notches, such as indicated at 103 and 104, respectively. These notches should always be at corresponding ends when the cutting head is assembled. It will be appreciated that any suitable means for making it easy for the operator to assemble the cutter and comb assembly in the proper manner may be provided.

So that the operator may readily know which side of the cutting head is useful for cutting leg hair and which side is useful for cutting underarm hair, the casing is preferably provided with suitable indicia. As illustrated in the drawings, there are provided on one side of the casing the words "For Legs," and on the other side of the casing the words "For Underarms." Obviously, this indicia will have no meaning unless the comb and cutter assembly is applied to the casing in a predetermined manner. To this end the casing 23 and comb assembly 22 are designed so that the comb assembly cannot be attached to the casing in operative relation therewith unless it is attached thereto with the correct orientation. Preferably, to facilitate the proper assembly without the trial and error method, the casing is provided on the side thereof adjacent which the colored or distinctive sides of the comb assembly and cutter should be positioned with a suitable indicia, such as the dot 106 indicated in FIG. 3 of the drawings. This dot may be a colored dot corresponding to the color used on the cutter and comb assembly. However, to insure against improper assembly should the operator ignore the indicia, there are provided on one side of recess 80 and adjacent each end thereof the projections 108, only one of which is visible in FIG. 8 of the drawings. However, these projections 108 cooperate with cut-away sections or rabbeted portions indicated at 109 (see FIG. 7 of the drawings) at each end of the U-shaped support 88. Thus, the comb and cutter assembly can only be attached in operative relationship with the casing and motor in one predetermined manner, thus positively insuring correct orientation thereof. Preferably, a pair of shoulders similar to the projections 108 are provided on the casing section 27 so as to space the comb portion 89 from the transverse projections 26g and 27g thereby to prevent the pinching and pulling of hairs into the spaces between the ends of the comb portion and the transverse projections.

For the purpose of protecting the cutting head, and particularly the comb which is exposed, there is preferably provided a suitable comb guard 110, shown only in FIGS. 2 and 3 of the drawings, which comb guard may be formed of a suitable plastic and which may be slipped over the head. Preferably, the comb guard 110 is of somewhat channel or U-shaped construction so that it

may be slipped over the cutting head and the legs of the U thereof will grip the casing 23 sufficiently to hold the comb guard in position. The particular construction of the comb guard forms no part of the present invention and any other suitable means for this purpose may be employed.

In order to hold the comb and cutter assembly in assembled position within the recess 80, there are provided a pair of spring clips 111. These spring clips 111 are preferably L-shaped, as best shown in FIG. 4 of the drawings. The short leg of the L is arranged to be disposed in cooperating notches defined in casing sections 26 and 27, so that the long arm of the L-shaped clips 111 extends substantially vertically along the ends of the recess 80. The upper end of the long arm of the L-shaped members 111 is provided with a laterally extending flange extending against the wall of the recess and effectively fitting into cooperating recesses or notches 112 defined in the end casing sections 26g and 27g. Thus, the midpoint of the long arm of the L-shaped members 111 can be distorted into the notches 112. To provide suitable latching means, the intermediate portion of each of the long arms of the L-shaped member 111 is provided with a protuberance 111a, extending into the recess 80, which protuberances are adapted to engage the ends of the right portion of the U-shaped support member 88, as is clearly shown in FIG. 4 of the drawings, thus holding the comb and cutter assembly in attached relationship with the casing 23 and with the cutter in driving engagement with the arm 55c of the bell crank 55. The spring clips 111 are resilient enough so that they will be distorted when the comb and cutter assembly is pushed into recess 80, and, conversely, the comb and cutter assembly may readily be removed by applying a small pulling force to the mushroom-shaped comb portion which will cause the latching portions 111a to release the comb and cutter assembly.

To accommodate the terminals 72 and 73, one section of the casing 23 is preferably provided with means to firmly support the insulating plate or terminal board 74. To this end, and as best illustrated in FIGS. 4 and 11 of the drawings, the casing section 26 is provided with an integral protuberance 26h within which is defined a recess 113, effectively providing a cord receptacle. The walls defining the recess 113 are furthermore provided with diametrically opposed notches 114 and 115 to receive therein the terminal board 74 and hold the same in a predetermined position with the terminal pins extending into the recess 113 and readily accessible with a more or less conventional plug connector of an associated power cord. To insure that the terminal board 74 will be held within the notches 114 and 115, the casing section 27, as is best shown in FIG. 12 of the drawings, is provided with a plurality of projections 27h which are positioned so as to engage the adjacent edge of the terminal board 74 when the casing is assembled.

A suitable power cord 116 is illustrated in FIGS. 1, 2, 3 and 11 of the drawings. This power cord is provided with a plug connector 117 insertable within the recess 113. To make sure that the plug connector 117 does not accidentally become disconnected from the terminal pins 72 and 73, the plug connector is preferably provided on the end insertable into recess 113 with an enlargement 117a which is adapted to move above a rib 26k defined in recess 113, which rib 26k is best shown in FIGS. 4 and 11 of the drawings. The plug connector 117 is preferably formed of a somewhat resilient insulating material, so that upon insertion into recess 113 it will distort enough to permit the enlargement or projection 117a to move above rib 26k thereby retaining the plug connector 117 against inadvertent removal.

In view of the detailed description included above, the operation of the cutting device designed especially for the removal of both leg hair and underarm hair will

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readily be understood by those skilled in the art. One side of the cutting head will cut no closer than the thickness of the comb stock employed, so that underarm irritation will not occur. On the other hand, the other side of the cutter head will cut much closer and is very satisfactory for removing leg hair. The comb and cutter are readily detachable from the casing, so that excess hair can be blown out. Moreover, means are provided to insure that improper positioning thereof cannot occur. Also, simple means are provided to insure the proper assembly of the cutter head and attachment thereof to the casing 23. A powerful motor is provided which is resiliently mounted in the casing and which has no parts that can move against each other to provide a loud noise.

The vibration of the motor is relatively small, and what vibration is present is prevented from being transmitted to the casing by the resilient mounting means provided. If desired, however, a modification shown in FIG. 13 of the drawings may be employed, where a fragmentary portion of the motor 24 is illustrated. As there illustrated, there is employed a counterweight 120 which is attached to the motor frame by an L-shaped spring arm 121. This counterweight will vibrate in opposition to the vibration produced by movement of the armature thereby reducing still further any vibrations produced by the motor 24. The weight 120 is shaped so that it will readily fit within the casing 23. As illustrated, the L-shaped arm is riveted to an L-shaped bracket 122, which bracket is secured to the field structure of the motor 24 by screws 123. The counterweight 120 and the spring arm 121 are so selected that the composite counterweight structure has a natural frequency of vibration substantially equal to twice the frequency of alternation of the energizing current for the shaver which for one particular type of shaver is sixty cycles per second. As will be clear to those skilled in the art, the counterweight 120 thus vibrates one hundred eighty degrees out of phase with the remaining vibrating structure thereby to minimize the over-all vibration of the shaver 20.

While there have been illustrated and described a particular embodiment of an electric hair removing device especially designed for the use of women and a modification thereof, it will be appreciated that numerous changes and modifications thereof will occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications that fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. For use in a hair removing device having hair cutting means, an alternating current motor for actuating said hair cutting means comprising a U-shaped magnetic structure including a pair of spaced pole faces defining an air gap therebetween, means for establishing an alternating current magnetic field across said air gap, an armature dimensioned to fit into said air gap with the longitudinal axis of said armature being generally parallel to a line extending between said pole faces, a bell crank pivoted about a pivotal axis disposed completely outside said magnetic structure, and means for bodily supporting said armature from one arm of said bell crank in a manner to cause said armature to move bodily into and out of the space between said pole faces.

2. The alternating current motor of claim 1 wherein said pivotal axis is at all times more remote from one end of said armature than from the other end.

3. The alternating current motor of claim 1 wherein said armature is formed of L-shaped laminations.

4. The alternating current motor of claim 1 in which said armature is pivoted about an axis closer to one end than the other end of said air gap and said armature is substantially L-shaped.

5. An electric hair removal device comprising a small flat circular housing defining a shallow cylindrical space

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therein, a reciprocating cutting assembly mounted on said housing along a portion of the peripheral edge thereof, an electric motor in said housing having a generally rectangular field structure comprising spaced apart pole faces defining an air gap therebetween, an armature bodily movable into and out of the space between said pole faces, said rectangular field structure being disposed in said cylindrical space with the corners thereof adjacent the periphery of said space, a bell crank pivotally mounted about a pivotal axis disposed completely outside said magnetic structure adjacent the periphery of said cylindrical space and far to one side of a line perpendicular to the longitudinal axis of said air gap at the midpoint of said longitudinal axis, said armature being rigidly secured to one arm of said bell crank, said arm being mounted for oscillation in the principal plane of said housing and connected to drive said cutting assembly.

6. A resonant type electric motor comprising a relatively flat metallic support frame, a magnetic field structure including spaced pole faces secured to said frame with the principal planes of said frame and said field structure being parallel, an armature pivotally mounted on one side of said frame completely outside the boundaries of said magnetic structure including said armature for movement in a path through an air gap defined between said pole faces, upstanding flanges integral with said frame, and a pair of springs respectively interposed between opposite sides of said armature and said flanges.

7. A resonant type electric motor comprising a magnetic field structure of generally C-shape, terminating in spaced opposed pole faces defining the opening in the C, an armature mounted for movement into and out of the space between said pole faces, a pair of opposed springs disposed one on either side of said armature for urging said armature to a normal or at rest position, said armature having a minimum thickness in the direction of movement thereof but being substantially wider in the other direction than the corresponding dimension of the associated field structure.

8. In a hair removing device, a vibrating motor consisting of a C-shaped field structure made in two sections, a bell crank, an armature rigidly secured to one arm of said bell crank and mounted to vibrate between the two sections, and tuned springs mounted to cooperate with said armature, an insulating spool to carry an electric winding, means for interlocking said field sections after they have been assembled through said spool, non-magnetic mounting plates on each side of said field sections and means for accurately locating and interlocking said field sections and said non-magnetic plates to form a rigid assembly, said non-magnetic plates having extensions beyond said field sections to serve as a pivoting support for said bell crank, and said plates having other extensions to locate and hold said tuned springs in relation to said armature.

9. In a hair removing device, a small thin circular housing which can readily be held in the hand of a user and defining a shallow cylindrical space therein, a cutting assembly mounted on said housing along one portion of the peripheral edge thereof, said assembly including a movable cutting member, an alternating current motor disposed within said housing and substantially filling said shallow cylindrical space, said motor comprising a U-shaped magnetic structure having spaced pole faces defining an air gap therebetween, means for establishing an alternating current magnetic field across said air gap, an armature dimensioned to fit into said air gap between said pole faces, a bell crank pivoted about an axis disposed completely outside said magnetic field and adjacent the periphery of said cylindrical space, means rigidly supporting said armature from one arm of said bell crank in a manner so that said armature moves bodily into and out of the space between said pole faces upon pivotal movement of said bell crank about said axis, and means for operatively connecting said bell crank and said cutting

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member, said U-shaped magnetic structure and said armature defining a rectangular structure of a thickness substantially that of the depth of said shallow cylindrical space with the corners of said rectangular structure disposed closely adjacent the periphery of said cylindrical space.

10. The hair removing device of claim 9 wherein said assembly includes a slotted comb and a reciprocating cutting member having a row of teeth on either side thereof.

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