ELECTRIC DRY SHAVING MACHINE WHEREIN THE CUTTER SHAFT IS MOUNTED IN A RUBBERLIKE MATERIAL

Filed Nov. 13, 1962

Fig. 1

Fig. 2

Fig. 3

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The present invention relates to apparatus for removing beards or face hair as well as for removing hair from the arms, legs and other portions of the human body, and is generally referred to as an electric dry shaver. More particularly, the present invention is in the nature of an improvement over the electric dry shaver disclosed and claimed in copending Jepson and Schuessler application Serial No. 109,551, filed May 12, 1961, and assigned to the same assignee as the present application.

The electric dry shaver disclosed in the above-mentioned copending Jepson and Schuessler application is one in which the hair to be removed, such as the beard, enters the cutting area through a network of small holes in a curved perforated comb. An oscillating cutter comprising a plurality of spaced parallel blades travels back and forth across the comb at high speed and is driven by centrifugal force against the inside surface of the comb, thus providing a very satisfactory cutting action with the comb. The cutting blades float in a cutter head and shaft assembly that is also oscillated by a powerful electric motor with the cutting blades oscillating on the order of 8,500 cycles per minute. In the above-mentioned copending application, the oscillating shaft for the cutting blades is supported in spaced bearings and the manufacturing cost of such a shaver is substantial due to the requirement of bearings which must be carefully aligned and which must either be lubricated or comprise bearings of the self-lubricating nature. It would be desirable to provide an arrangement in which the bearings for the oscillating cutter shaft could be completely eliminated, thereby eliminating the cost of such bearings, the more complicated assembly thereof and all misalignment problems with respect thereto.

It will be appreciated that in a shaver in which the cutting blades are oscillated, at each end of the stroke the blades must come to a stop and then movement in the opposite direction must take place. This means that at each end of the stroke it is necessary to overcome the inertia of the moving parts which are momentarily in a stationary condition. It would be desirable to provide an arrangement wherein it is unnecessary to overcome the inertia of the cutting stroke to move it in the opposite direction, but in some manner to provide an energy storage arrangement whereby energy stored during a portion of the operating stroke is released to overcome this inertia for the return stroke. Moreover, it would also be desirable to provide some sort of resilient stop whereby the blade assembly which stops momentarily at each end of the stroke is cushioned to such stop.

In oscillating shavers of the type disclosed in the above-mentioned copending Jepson and Schuessler application, to insure the proper balance of the movable portions of the cutter head and assembly, it was necessary to provide counterbalancing means commonly in the form of a counterweight of some sort which, of course, increased the mass of the oscillating structure, and, secondly, produced a space problem in making provision for such counterbalancing means which is usually in the form of a weight of some sort. It would be desirable to provide an arrangement which permits one to eliminate such counterbalancing means.

In the dry shaver of the oscillating cutter type, particularly one employing a plurality of blades, such as disclosed in the copending Jepson and Schuessler application, a very powerful motor is required to oscillate the cutters and supporting mechanism therefor at the high speeds desired for proper cutting operation. It would be desirable to provide an improved power system whereby with the same comb structure and the same cutter structure a power reduction of between twenty and fifty percent could be obtained.

Accordingly, it is an object of the present invention to provide a new and improved electric dry shaver.

It is another object of the present invention to provide a dry shaver of the type employing an oscillating cutting mechanism wherein the conventional bearings for the oscillating shaft may be completely eliminated with the consequent elimination of the bearing misalignment problem.

It is a further object of the present invention to provide a new and improved dry shaver whereby the same cutting action is obtained with a reduction in power input of between twenty and fifty percent.

It is another object of the present invention to provide a cutter mechanism for an electric dry shaver in which the lubrication problem is completely eliminated.

Still another object of the present invention resides in an electric dry shaver having a rotating motor feeding power to an oscillating cutter mechanism wherein the requirement to overcome the inertia of the cutter blade assembly at each end of its stroke when the direction of motion is changed is eliminated and instead stored energy is utilized to act as a cushioned stop and, moreover, overcome the inertia with respect to movement in the opposite direction.

It is a further object of the present invention to provide an oscillating cutter mechanism for an electric dry shaver in which the counterbalancing problem is completely eliminated.

It is a further object of the present invention to provide an improved electric dry shaver which will give years of trouble-free service and which can be manufactured and assembled at a greatly reduced cost.

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 fragmentary, longitudinal sectional view taken along a plane passing substantially through the axes of the shafts of the rotating motor and oscillating cutter of an electric dry shaver embodying the present invention;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1 assuming that FIG. 1 shows the complete structure;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 1 again assuming that FIG. 1 shows the complete structure;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 1 assuming that FIG. 1 shows the complete structure;

FIG. 5 is an enlarged fragmentary sectional view of the supporting means for the oscillating shaft of the cutter mechanism; and

FIG. 6 is an exploded perspective view of the oscillating blade supporting mechanism and the means for supporting the same in the electric dry shaver of the present invention.

Briefly, the present invention is concerned with an improved oscillating cutter assembly for an electric dry shaver wherein the bearings for the oscillating cutter...
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The ends of this cutter shaft are resiliently mounted. In the preferred embodiment, the ends of the cutter shaft are nec-

essitated by the flanges 15 and 16 which form the end caps at each end of the oscillating member. The casing sections 15 and 16 are effectively end caps which

are molded of a plastic material while the end cap 16 was made as a die casting of a suitable metal.

In accordance with the arrangement disclosed and claimed in Jepson et al. application Serial No. 322,795 referred to above, the shaver 10 includes a molded in-

sulating support or chassis 20 to which the cutter as-

sembly 11 and the motor 15 are mounted in the manner described hereinafter. When the motor or chassis 20 is associated with the shaver 10, it actually divides the shaver casing into two chambers—a motor chamber 21 disposed beneath the chassis 20, and a cutting chamber 22 disposed above the member having an open top and a closed bottom (not shown). The casing sections 15 and 16 are effectively end caps which may be molded of a suitable plastic material in the same manner as the casing section 14. Actually, in an embodiment built in accordance with the present invention, the end cap 15 was molded of a plastic material while the end cap 16 was made as a die casting of a suitable metal.

The casing sections 14, 15 and 16 form part of the present invention but may be very similar to the corresponding parts dis-

closed in the copending Jepson and Schuessler application referred to above. Housed within the casing, comprising three parts 14, 15 and 16, is a suitable electric motor, generally designated at 18, which is adapted to be connected by suitable driving means, generally designated at 19, with the cutter mechanism 11 in order to cause oscillation of this cutter mechanism at a speed of the order of 8,500 cycles per minute.

As is fully disclosed in the aforesaid Jepson et al. application, the casing for the electric shaft is of boxlike configuration so that it may readily be held in the hand of the user and no further discussion of this feature is included herein. Moreover, the casing is manufactured in three sections, as described in the aforesaid copending applications, in order to facilitate assembly of the electric dryer and the accompanying joints. Actually, the casing section 14 preferably molded from a suitable plastic material is a rectangular cup-shaped member having an open top and a closed bottom (not shown). The casing sections 15 and 16 are effectively end caps which

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tation, the end cap 15 was molded of a plastic material while the end cap 16 was made as a die casting of a suitable metal.
art, and a field winding, not shown, surrounds a portion of these laminations. As is disclosed in the co-pending Jepson et al. application, Serial No. 322,795, the field structure including the laminations 47 is supported from chassis 20 by a pair of bail clamps 48, which in turn are supported by a molded bail hanger 49 resting on the top of chassis 20. Actually, the chassis 20 is provided with suitable openings through which the bail clamps 48 may extend to engage the bail hanger 49.

To support the chassis 20 and the motor and cutting mechanism mounted thereon with respect to the casing, the chassis 20 is provided with a peripheral laterally projecting flange 20d which is adapted to engage a cooperating lug 50 defined around the periphery of the end of the cup-shaped casing portion 14, as best shown in FIGS. 1, 2, 3, and 4 of the drawings. It will be appreciated that the subassembly comprising the chassis 20, to which have been secured the armature and field structure described heretofore of motor 18, as well as the cutting mechanism 11 to be described and the end caps 15 and 16, is then associated with the cup-shaped casing section 14 by inserting the depending portion thereof into this casing section, whereupon the latter can then be secured to suitable means supported by the bail clamps 48 to complete the assembly.

A plurality of support suitable comb locks, not shown, for retaining the comb 13 in position, as disclosed in the above-mentioned Jepson patent, there is provided a comb lock spring 51 (FIGS. 1 and 6) which is interposed between the chassis 20 and the bail hanger 49. If desired, the chassis 20 may be provided with integral projections such as 20e (FIG. 1) for temporarily retaining the comb lock spring 51 in position during assembly. It will be understood that the bail clamps 48 clamp the comb lock spring between chassis 20 and bail hanger 49 upon final assembly of all parts.

As in the above-mentioned co-pending Jepson and Schuessler application, Serial No. 109,531, the cutter assembly 11 includes a cutter shaft 52 disposed in spaced parallel relationship with the motor shaft 30. In order resiliently to support a plurality of cutter blades, such as 12, for oscillation with the cutter shaft 52, the latter is provided with a plurality of upwardly extending supports 53a, 53b, 53c, and 53d which may be identical with those disclosed in the above-mentioned co-pending Jepson and Schuessler application. These supports are of triangular shape and are rigidly secured to the cutter shaft 52. They are provided with suitable slots to receive the cutter blades 12 and spring 63 therein in the same manner disclosed in the Jepson and Schuessler application referred to above. The details of a particular embodiment illustrating one arrangement of the supports is best shown in FIG. 6 of the drawings.

In accordance with the present invention, conventional bearings for the oscillating cutter shaft 52 have been completely eliminated and instead opposite ends of this cutter shaft are knurled as indicated at 52a and 52b (FIG. 5), and a pair of rectangular blocks of a resilient material, preferably a neoprene rubber, designated at 54 and 55 are securely bonded to the knurled portions 52a and 52b of shaft 52.

In order to support the oscillating shaft 52, the chassis 20 is provided with a pair of upwardly projecting support portions 20f and 20g, each of which is provided with an upwardly directed V-shaped notch 57 and 58, respectively. These V-shaped notches 57 and 58 are respectively adapted to receive thereinto resilient supports 54 and 55 bonded to shaft 52. To clamp the resilient supports 54 and 55 into notches 57 and 58, the end caps 15 and 16 are provided with cooperating V-shaped notches 59 and 60, respectively. Thus, end cap 15 is provided with a projection 15a having arcuately arranged comb supporting surfaces 15b. Moreover this projection 15a is provided with the downwardly directed V-notch 59 cooperating with the V-notch 57 in the support 20f so as to clamp the resilient block of neoprene rubber 54 into fixed position relative to chassis 20. Similarly, the end cap 16 is provided with a projection 16a having a downwardly directed V-notch 60 whereby the resilient support 55 may be clamped into position within the cooperating notches 58 and 60. End cap 16 is also provided with arcuately arranged comb supporting surfaces 16b (FIG. 3). As was described earlier, screws such as 41 (FIGS. 1 and 4) clamp the end cap 15 to the chassis 20 simultaneously holding the commutator end bearing retainer 32 and, hence, the bearing 23 in position and also clamping the resilient support 54 in fixed position. Similarly, a pair of screws 62 (FIG. 2) are provided for clamping the end cap 16 to the chassis 20 and simultaneously clamping the resilient support 55 for the oscillating shaft 52 in position.

The driving means 19 includes a combined crank and counterweight comprising crank pin 63 and counterweight 64 secured to the end of oscillating shaft 52 adjacent the crank end of motor shaft 30, the shafts 30 and 52 being substantially coextensive. The driving means 19 is designed to be connected to the other end of driving rod 45, this connecting rod passing through opening 46 in chassis 20.

In an electric shaver built in accordance with the present invention, the resilient blocks 54 and 55 had a natural frequency of vibration of between 5500 and 7500 cycles per minute. These blocks were made of neoprene rubber and had a Durometer hardness of between 40 and 45. This material was resistant to ozone gas, had a tensile breaking stress of at least 3500 pounds and met many tests with respect to resilience, compression set, elongation, and the like. The material should be resilient enough so as not excessively to increase the starting torque and yet should have sufficient hardness to store a substantial amount of energy when the blocks are stressed in torsion. With this arrangement efficiency was increased in excess of twenty percent and the cost of manufacture and assembly was greatly reduced by the elimination of bearings, by the elimination of bearing and shaft burnishing previously required by the elimination of shaft bearing alignment problems, as well as by completely obviating any requirement for lubrication. Furthermore, it was unnecessary to counterbalance the cutter shaft assembly as hereinafter required, thus further reducing the manufacturing cost.

It should be understood that instead of utilizing resilient blocks of rubberlike material for storing energy other resilient means, such as resilient springs or the like, may be employed for this purpose in connection with a rotary motor which supplies energy through a driving means to an oscillating mechanism. An arrangement for storing energy in connection with an oscillating cutter shaft utilizing compression springs for this purpose is shown in co-pending Jepson and Kukulski application Serial No. 246,488, filed December 21, 1962, and assigned to the same assignee as the instant application. It should be understood that such resilient spring means might be employed instead of the blocks 54 and 55 or in addition thereto for storing energy to be fed back into the power train at each end of the oscillating stroke.

In view of the detailed description set forth above, the operation of the electric shaver of the present invention will readily be understood by those skilled in the art. As the electric motor 18 rotates, it causes oscillation of the cutting blocks 52 through oscillating mechanism 11 in torsion as the oscillating cutter mechanism moves from one end of its stroke to the other. Energy is stored in these resilient blocks as the cutting mechanism moves to the end of its stroke. The blocks cushion the mechanism to a stop and the stored energy in the resilient blocks then overcomes the inertia of the moving parts and gives up this energy in producing movement in the opposite direction. Consequently, a smaller motor is required.
and much more efficient utilization of the output of the motor 18 is accomplished.

From the above description it will be apparent that without the energy storage means of the present invention, very high bearing pressures will result such as at the crank pins 44 and 63, etc., each time the oscillating cutter mechanism slows down or accelerates at the ends of each stroke. This is because of the substantial mass of the oscillating parts. These high bearing pressures mean high friction losses and, hence, inefficient use of the energy available. By providing the energy storage means of the present invention associated with the oscillating cutter shaft, the friction losses due to high bearing pressures are greatly reduced. For example, upon deceleration the kinetic energy, by virtue of the momentum of the mass of the oscillating system, will be stored in the energy storage means whereby it is immediately available to accelerate the mass at the time the direction of movement is reversed. Thus, less torque is required from the prime mover and, consequently, lower bearing pressures are involved at the crank pins 44 and 63. In other words, with the present invention more uniform stress is experienced in each stroke of the oscillating mass occur, and a more constant load is applied to the prime mover resulting in higher efficiency and, hence, less power consumption. If one assumed that the oscillating cutting mechanism had zero mass, then the use of the energy storage means in accordance with the present invention would be undesirable since it would merely increase the load on the prime mover and provide no benefits. Of course, since all oscillating mechanical systems involve substantial mass, the desirable features of the present invention result.

As was pointed out above, the theoretical ideal condition would be to have the energy storage means tuned to the frequency of oscillation produced by the prime mover. It has been found, however, that this requires energy storage means of such stiffness that a practical prime mover would not be able to produce sufficient torque to initiate oscillation of the system. For this reason the natural frequency of the energy storage means is tuned to a frequency lower than the frequency of oscillation of the oscillating cutter mechanism.

While there have been illustrated or described several embodiments of the present invention, it should be understood that numerous changes and modifications will occur to those skilled in the art, and it is intended by the appended claims to cover all those changes and modifications which 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. In combination, an electric motor comprising a rotating shaft, an oscillating cutting means including a cutter shaft disposed in spaced parallel relationship with respect to said motor shaft, means interconnecting said shafts to convert rotary motion of said motor shaft to oscillating motion of said cutter shaft, and resilient means securing said cutter shaft, said resilient means being stressed in torsion in one direction and then in the other upon oscillation of said cutter shaft.

2. An electric shaver comprising a housing, an electric motor including a rotatable shaft mounted in said housing, an oscillating cutting means supported in said housing including an oscillating cutter shaft disposed in spaced parallel relationship with respect to said motor shaft, means interconnecting said shafts to convert rotary motion of said motor shaft to oscillating motion of said cutter shaft, and resilient means encompassing and firmly secured to the ends of said cutter shaft, said resilient means being held in fixed position in said housing and stressed in torsion upon oscillation of said cutter shaft.

3. An electric shaver comprising a housing, an electric motor including a rotatable shaft mounted in said housing, an oscillating cutting means supported in said housing including an oscillating cutter shaft disposed in spaced parallel relationship with respect to said motor shaft, means interconnecting said shafts to convert rotary motion of said motor shaft to oscillating motion of said cutter shaft, a first rectangular block of rubber bonded to one end of said cutter shaft, a second rectangular block of rubber bonded to the other end of said cutter shaft, means for clamping said blocks of rubber in stationary position in said housing whereby oscillation of said cutter shaft causes said blocks of rubber to be stressed in torsion, said rubber blocks storing energy from said prime mover when said cutter shaft is moved toward the extreme ends of its oscillating stroke and returning energy to said oscillating cutting means when said cutter shaft is moved away from the extreme ends of its oscillating stroke.

4. An electric shaver comprising a housing, an electric motor including a rotatable shaft mounted in said housing, an oscillating cutting mechanism supported in said housing including an oscillating cutter shaft disposed in spaced parallel relationship with respect to said motor shaft, means interconnecting said shafts to convert rotary motion of said motor shaft to oscillating motion of said cutter shaft, a first rectangular block of rubber bonded to one end of said cutter shaft, a second rectangular block of rubber bonded to the other end of said cutter shaft, means in said housing defining opposed V-shaped grooves for clamping said blocks of rubber in stationary position in said housing when said housing is fully assembled whereby oscillation of said cutter shaft causes said blocks of rubber to be stressed in torsion, said rubber blocks storing energy from said prime mover when said cutter mechanism is moved toward the extreme ends of its oscillating stroke and returning energy to said cutter mechanism when said cutter mechanism is moved away from the extreme ends of its oscillating stroke, said stored energy overcoming the inertia of said cutter mechanism as it reverses its direction of movement.

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