April 5, 1966 I. JEPSON 3,244,916

ROTARY POWER DEVICE WITH MOTION CONVERSION MEANS

Original Filed Nov. 13, 1962 2 Sheets-Sheet 1

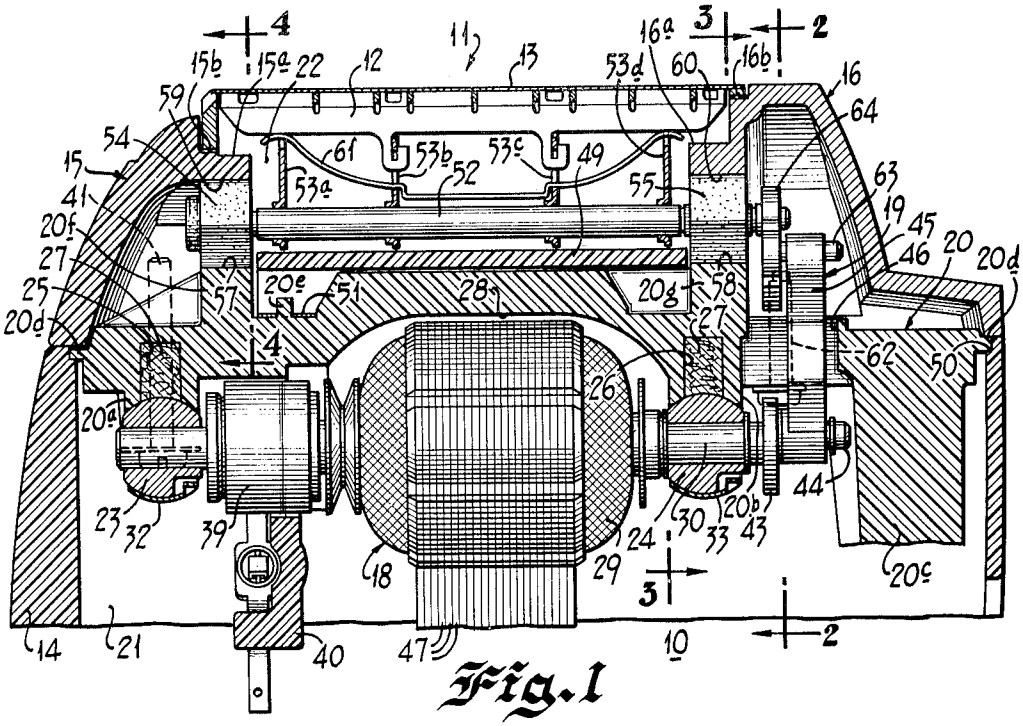


Fig. 1

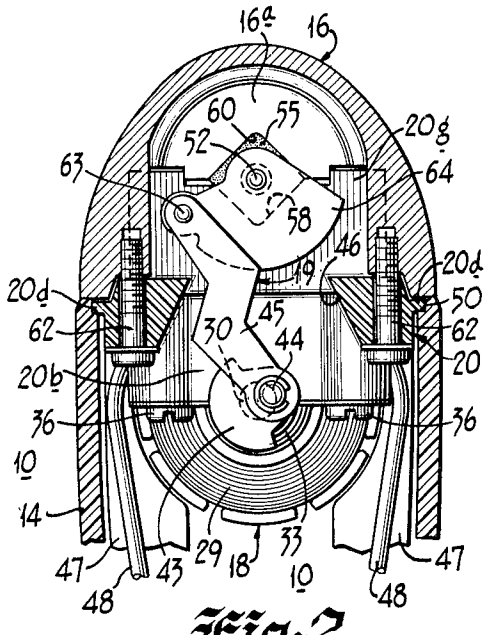


Fig. 2

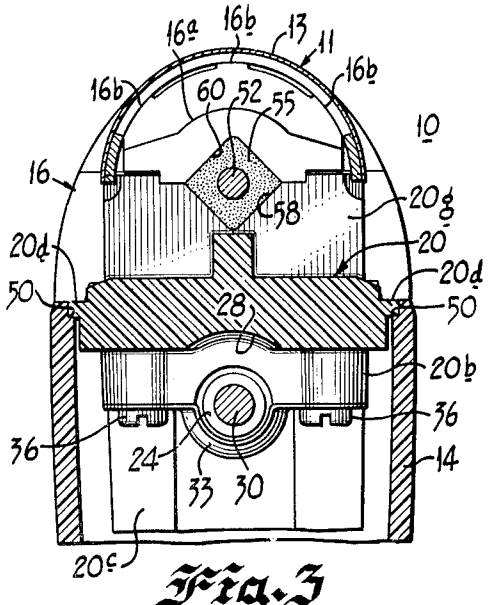


Fig. 3

INVENTOR.
IVAR JEPSON
BY George R. Clark
ATTORNEY

April 5, 1966 I. JEPSON 3,244,916

ROTARY POWER DEVICE WITH MOTION CONVERSION MEANS

Original Filed Nov. 13, 1962 2 Sheets-Sheet 2

Fig. 4

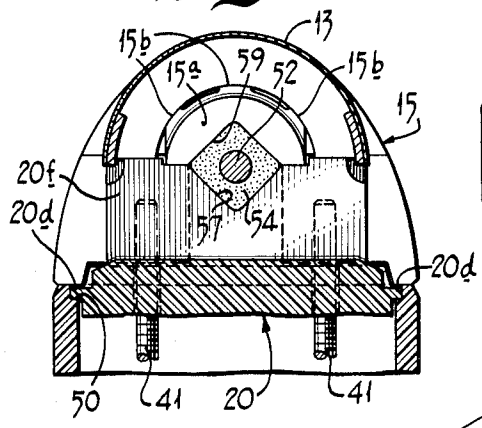


Fig. 5

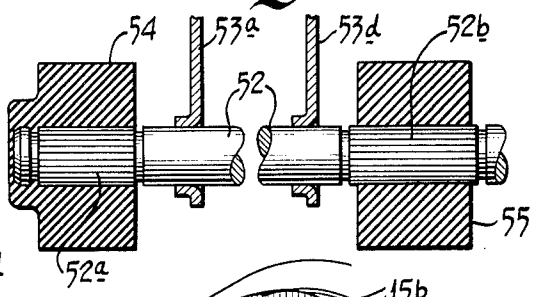
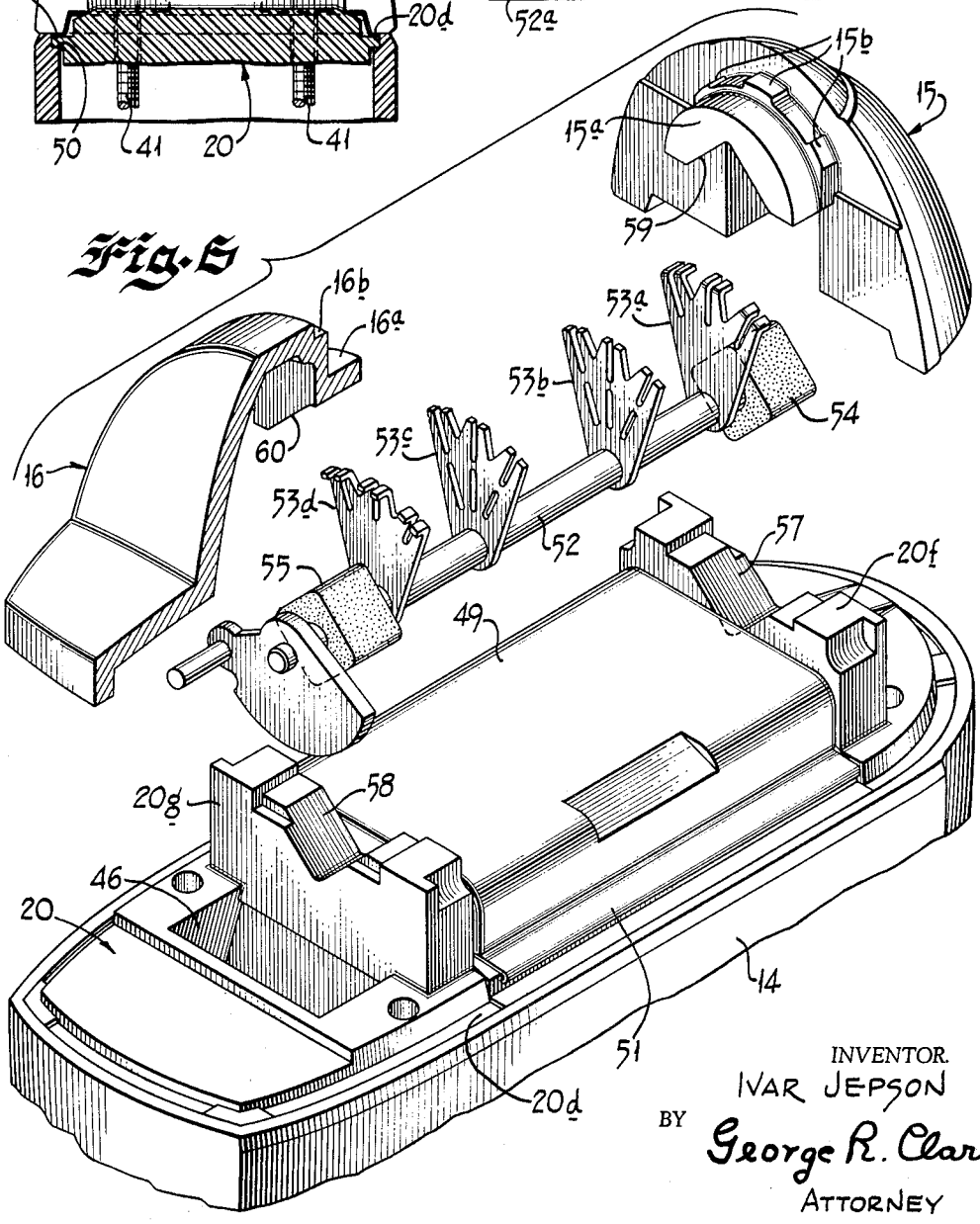


Fig. 6



INVENTOR.
IVAR JEPSON
BY George R. Clark
ATTORNEY

United States Patent Office 3,244,916 Patented Apr. 5, 1966

3,244,916

ROTARY POWER DEVICE WITH MOTION CONVERSION MEANS

Ivar Jepson, Sister Bay, Wis., assignor to Sunbeam Corporation, Chicago, Ill., a corporation of Illinois

Original application Nov. 13, 1962, Ser. No. 237,239, now Patent No. 3,206,850, dated Sept. 21, 1965. Divided and this application Nov. 10, 1964, Ser. No. 410,115

10 Claims. (Cl. 310—80)

The present application is a division of copending Jepson application Serial No. 237,239, filed November 13, 1962, now Patent No. 3,206,850, and assigned to the same assignee as the instant application. It relates to an electric appliance of the type in which a prime mover drives an oscillating cutter, and more specifically to such an appliance useful 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, now Patent No. 3,196,539, 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 thrown by centrifugal force against the inside surface of the comb, thus providing a very satisfactory cutting action with the comb. The cutter blades float in a cutter head and shaft assembly that is also oscillated by a powerful electric motor with the cutter blades oscillating on the order of 8500 cycles per minute. In the above-mentioned copending Jepson and Schuessler 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 blade assembly at the ends of the oscillating strokes 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 or 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 Jepson and Schuessler application, to insure the proper balance of the movable portions of the cutter head 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 above-mentioned 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 power unit especially useful for use in an electric dry shaver.

It is another object of the present invention to provide an appliance of the type employing an oscillating mechanism wherein the conventional bearings for the oscillating mechanism 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 appliance employing a cutting mechanism 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, overcomes the inertia with respect to movement in the opposite direction.

It is a still 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 shaft are completely eliminated and instead the ends of this cutter shaft are resiliently mounted. In the preferred embodiment the ends of the cutter shaft are secured to blocks of a rubberlike material whereby bearings and lubrication problems are completely eliminated, the alignment problem is eliminated and a greatly reduced power requirement is obtained since energy stored in the resilient support is fed back into the power system at each end of the oscillating stroke, thereby overcoming the inertia inherent in a device which must stop and reverse its direction of movement. By eliminating the bearings a sound reduction of the order of twenty-five to thirty percent results. The resilient means for mounting the oscillating shaft is preferably chosen to have a natural frequency of vibration which approaches the frequency of oscillation of the cutter mechanism. Moreover, the resilient support means must be such as to be unaffected by the various shaving lotions that might be employed and unaffected by ozone which is produced with a commutator-type motor. Due to the resonant condition and the fact that energy is stored in the resilient supports and is released to overcome the inertia of the oscillating shaft and blade assembly at each end of the stroke, a substantial reduction in power requirements results. This reduction is between twenty and fifty percent. Moreover, the resilient mounting means for the oscillating shaft effectively provides a stop to cushion the oscillating cutters at each end of the stroke. Moreover, it is unnecessary to counterbalance the cutter assembly with this type of arrangement.

Referring now to the drawings, the electric dry shaver embodying the present invention is generally designated by the reference numeral **10**. Since the present invention is primarily concerned with the oscillating cutter mechanism and the power train and power supplying mechanism connected therewith, only fragmentary views of the entire shaver are shown. It should be understood, however, that this shaver might otherwise be very similar to that disclosed in the above-mentioned Jepson and Schuessler application. Moreover, the general construction of the shaver may be very similar to that disclosed and claimed in a copending application Serial No. 322,795, Jepson, Schuessler, Jackson and Jensen, filed November 12, 1963, also assigned to the same assignee as the instant application. Essentially, the shaver **10** comprises a cutting mechanism generally designated at **11** comprising a plurality of cutting blades **12**, only one of which is visible in the drawings, coacting with a comb or stationary cutting member **13**. The comb and cutting mechanism are associated with a suitable casing comprising three parts **14**, **15** and **16**, the comb **13** preferably comprising a substantial portion of the surface of the casing. The particular construction of the casing portions **14**, **15** and **16** forms no part of the present invention but may be very similar to the corresponding parts disclosed in the copending Jepson and Schuessler application Serial No. 109,551 referred to above. Housed within the casing, comprising portions **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 8500 cycles per minute.

As is fully disclosed in the aforesaid Jepson et al. copending applications, the casing for the electric shaver

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 dry shaver **10**. 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 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.

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 insulating support or chassis **20** to which the cutter assembly **11** and the motor **18** are mounted in the manner described hereinafter. When the member 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**, as viewed in FIG. 1 of the drawings, and a cutting chamber **22** disposed above the member **20**. The underside of the chassis member **20** is provided with a pair of downwardly directed spaced projecting portions **20***a* and **20***b* terminating in spherical surfaces for retaining spherical motor bearings **23** and **24**, respectively. The portions **20***a* and **20***b* are provided with recesses **25** and **26**, respectively, for receiving suitable oil wicks **27** preferably saturated with a suitable lubricant.

Between the projecting portions **20***a* and **20***b* of the chassis **20** is a portion defining a recess **28** for accommodating the armature **29** of the motor **18** which is supported on a shaft **30** journalled in the bearings **23** and **24**. The bearings **23** and **24** are secured within the spherical recesses defined at the lower end of the projections **20***a* and **20***b* of the chassis **20** by suitable bearing retainers **32** and **33**, respectively, which thereby hold the motor **29** in assembled relationship with the chassis **20**. The bearing retainer **32**, which might be termed the commutator end bearing retainer, is suitably secured to the chassis **20** by screws or other fastening means **41** which actually extend through the chassis into tapped openings in the end cap **15**, thereby simultaneously securing the bearing retainer **32** and the end cap **15** in assembled relationship with the chassis **20**. The bearing retainer **33**, on the other hand, which might be termed the crank end bearing retainer, is secured to the chassis **20** by suitable screws or fastening means **36**, best shown in FIGS. 2 and 3 of the drawings.

The chassis **20** is further provided with a downwardly projecting support member **20***c* only a portion of which is shown in the drawings for supporting suitable terminal pins whereby electrical connection may be made for energizing the electric motor of the present invention. If it is desired to provide a separate switch built into the shaver housing as is shown in the above-mentioned Jepson and Schuessler application Serial No. 109,551, then the projection **20***c* may support a suitable switch supporting member which, in turn, may also support the electrical terminals.

The particular construction of the motor **18** forms no part of the present invention, but as disclosed in Jepson Patent No. 2,688,184 includes a commutator **39** with which is associated a brush terminal assembly **40** (FIG. 1) suitably secured to the chassis **20** by fastening means (not shown).

For the purpose of converting rotary motion of the motor shaft **30** to oscillating motion of the cutter assembly **11**, the end of the motor shaft **30** adjacent crank and bearing retainer **33** is provided with suitable combined crank and counterweight means including a counterweight **43** and a crank pin **44**. The crank pin **44** is connected

to one end of a connecting rod 45 preferably formed of nylon which extends through an opening 46 (FIGS. 1, 2 and 6) in the chassis 20. The motor 18 includes the conventional field structure very similar to that shown in the above-mentioned Jepson patent. Only the laminations 47 are visible in FIGS. 1 and 2 of the drawings. These laminations include a portion surrounding the armature 29, as is well understood by those skilled in the art, and a field winding (not shown) surrounds a portion of these laminations. As is disclosed in the copending 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 20*d* which is adapted to engage a cooperating ledge 50 defined around the periphery of the open 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.

In order to 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 20*e* (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 copending Jepson and Schuessler application Serial No. 109,551, 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 53*a*, 53*b*, 53*c* and 53*d* which may be identical with those disclosed in the above-mentioned copending 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 suitable blade springs 61 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 52*a* and 52*b* (FIG. 5), and a pair of rectangular blocks of a resilient material, preferably a neoprene rubber, designated as 54 and 55, are securely bonded to the knurled portions 52*a* and 52*b* of shaft 52.

In order to support the oscillating shaft 52, the chassis 20 is provided with a pair of upwardly projecting support portions 20*f* and 20*g*, 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 therein the 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 15*a* having arcuately arranged comb supporting surfaces 15*b*. Moreover, this projection 15*a* is provided with the downwardly directed V-notch 59 cooperating with the V-notch 57 in the support 20*f* 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 16*a* 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 16*b* (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 crank pin 63 is adapted to be connected to the other end of connecting 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 resiliency, 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 heretofore 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 copending Jepson and Kukulski application Serial No. 246,488, filed December 21, 1962, now Patent No. 3,213,301, 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 cutter shaft 52 stressing the resilient blocks 54 and 55 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 whereupon 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 bearing pressures throughout the operating 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 mcehanical 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, power means including a rotatable power output shaft, driven means including an oscillating shaft, means interconnecting said shafts to convert rotary motion of said rotatable shaft to oscillating motion of said oscillating shaft, energy storage means having a portion thereof connected to said oscillating shaft, and means for holding another portion of said energy storage means in a fixed position, said energy storage means storing and giving up energy upon oscillation of said oscillating shaft by said power means.

2. The combination of claim **1** wherein said energy storage means comprise a pair of rectangular blocks of rubberlike material, one bonded to each end of said oscillating shaft.

3. An appliance comprising a prime mover including a rotatable shaft, driven means including an oscillating shaft, means interconnecting said shafts to convert rotary motion of said rotatable shaft to oscillating motion of said oscillating shaft, a first rectangular block of rubber bonded to one end of said oscillating shaft, a second rectangular block of rubber bonded to the other end of said oscillating shaft, means for clamping said blocks of rubber in stationary position whereby oscillation of said oscillating shaft causes said blocks of rubber to be stressed in torsion, said rubber blocks storing energy from said prime mover when said oscillating shaft is moved toward the extreme ends of its oscillating stroke and returning energy to said oscillating shaft when moved away from the extreme ends of its oscillating stroke.

4. The appliance of claim **3** wherein the ends of said oscillating shaft are knurled and said blocks are bonded to said knurled portions.

5. The appliance of claim **3** wherein said blocks have a natural frequency of vibration approaching the frequency of oscillation of said driven means including said oscillating shaft.

6. The appliance of claim **3** wherein said blocks are formed of neoprene rubber having sufficient hardness to store a substantial amount of energy when said blocks are stressed in torsion but yet resilient enough so as not excessively to increase the starting torque.

7. In combination a rotatable driving shaft, driven means including an oscillating shaft, means interconnecting said shafts to convert rotary motion of said rotatable shaft to oscillating motion of said oscillating shaft, energy storage means of resilient material surrounding said oscillating shaft and bonded there, and means for restraining said energy storage means at positions radially spaced from said oscillating shaft.

8. An appliance comprising power means including a rotatable power output shaft, driven means including an oscillating shaft, means interconnecting said shafts to convert rotary motion of said rotatable shaft to oscillating motion of said oscillating shaft, energy storage means of resilient material surrounding said oscillating shaft and bonded thereto, and means for restraining said energy storage means at positions radially spaced from said oscillating shaft, said energy storage means storing and giving up energy upon oscillation of said oscillating shaft and also serving as bearing means for said oscillating shaft.

9. The combination of a rotatable driving shaft, driven means including an oscillating shaft, means interconnecting said shafts to convert rotary motion of said rotatable shaft to oscillating motion of said oscillating shaft, a first energy storage means of resilient material surrounding said oscillating shaft and bonded thereto adjacent one end thereof, a second energy storage means of resilient material surrounding said oscillating shaft and bonded thereto adjacent the other end thereof, and means for restraining each of said energy storage means at positions radially spaced from said oscillating shaft.

10. An appliance comprising power means including a rotatable power output shaft, driven means including an oscillating shaft, means interconnecting said shafts to convert rotary motion of said rotatable shaft to oscillating motion of said oscillating shaft, energy storage means of resilient material surrounding said oscillating shaft and bonded thereto, said energy storage means effectively defining bearing means for said oscillating shaft, and means for restraining said energy storage means at points radially spaced from said oscillating shaft.

References Cited by the Examiner

UNITED STATES PATENTS

1,583,877	5/1926	Hahnemann et al.	73—92 X
2,263,625	11/1941	Gregg	74—75
2,844,958	7/1958	Bennett et al.	73—99

MILTON O. HIRSHFIELD, *Primary Examiner.*

ORIS L. RADER, *Examiner.*

C. W. DAWSON, *Assistant Examiner.*