June 13, 1967 E. SALI 3,324,545

RECIPROCATING OR VIBRATORY ELECTRIC RAZOR

Filed March 24, 1966

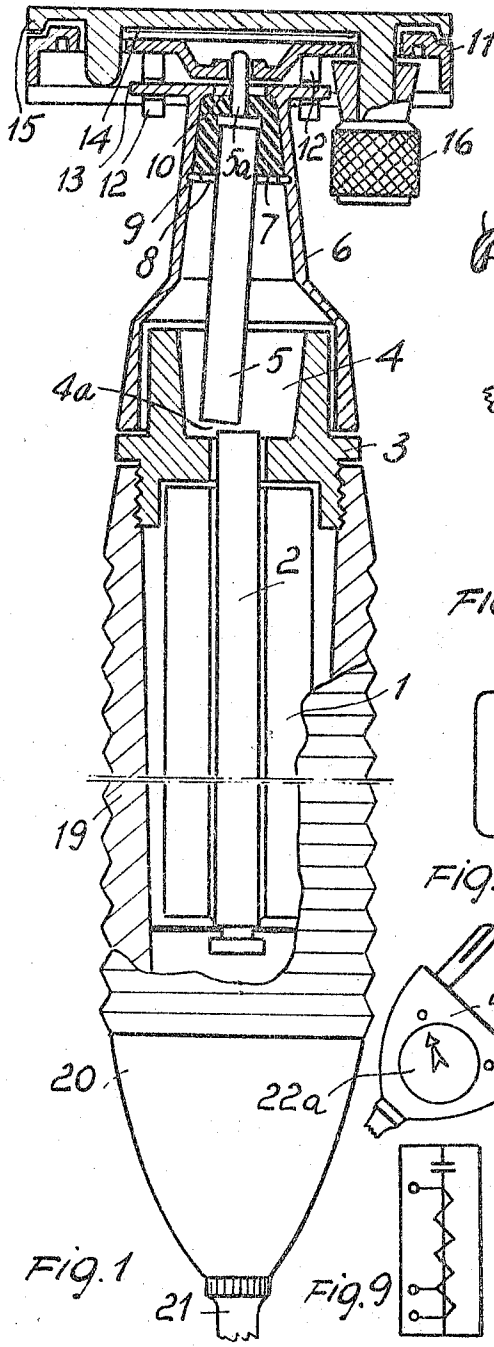

FIG. 1

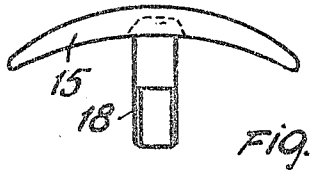

FIG. 2

FIG. 3

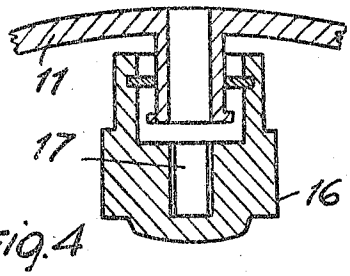

FIG. 4

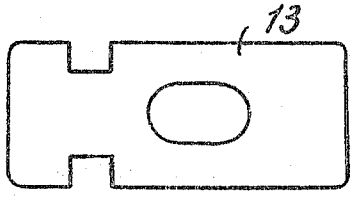

FIG. 5

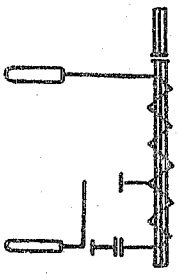

FIG. 6

FIG. 8

FIG. 10

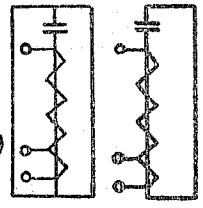

FIG. 9

FIG. 7

INVENTOR.
Evelino Sali
BY
Agent

United States Patent Office

3,324,545

Patented June 13, 1967

3,324,545

RECIPROCATING OR VIBRATORY ELECTRIC RAZOR

Evelino Sali, Via Vigliani 10, Milan, Italy

Filed Mar. 24, 1966, Ser. No. 537,139
Claims priority, application Italy, Apr. 3, 1965, 7,467/65
2 Claims. (Cl. 30—45)

The present invention relates to an electric shaver with reciprocating and vibrating head provided with a removable razor-blade.

It is an object of the present invention to provide an electric shaver, which besides all the advantages shown by the known shavers involving the use of soap or other emollient material for the shaving, and by the electric shavers for dry-shaving, provides a composite cutting action with a substantial component in the tangential direction of the hairs to be cut.

It is another object of this invention to provide an electric shaver which due to its operation and configuration allow to attain very good results in shaving by simple and cheap means.

The electric shaver according to the invention includes a head assembly, a razor-blade supported by said head assembly and having at least one cutting edge extending along at least one shaving side of said head assembly and a hand grip member, and is characterized in that it comprises a connecting assembly transmissively connecting said head assembly with said grip member and electro-magnetic means for imparting a reciprocating and vibrating motion to said razor blade within a plane parallel to the cutting edge of said razor blade.

Further characteristic features and advantages of the invention will appear from the following detailed description of preferred non limiting embodiments of an automatic device according to the present invention when taken in conjunction with the accompanying drawing in which:

FIG. 1 is a partially sectional view of the electric shaver according to the invention,

FIGS. 2, 3 and 4 are side views of component members of the support frame,

FIG. 5 is a plan view of a connecting member, FIGS. 6, 7, 8 and 9 are electric diagrams of a modified form of the invention, and FIG. 10 shows a current plug.

Referring now to the above figures, electromagnet 1 has a magnetic iron core 2 arranged with its longitudinal axis concentrically to the diamagnetic support element 3 having a central cavity 4 within which a pole of the electromagnet is seated at the bottom surface thereof. Opposite to this pole, there is a second core element or armature bar 5 defining a suitable magnetic gap 4*a* and having the same magnetic permeability features as the main core 2. Core 5 is housed within the diamagnetic cap 6, which in turn is inserted on the support element 3. The head of core 5 is embedded into a resilient liquid-proof seal and block members 7 and held in its seating by the radial springing washer 8, inserted in the circular groove 9. Armature bar 5 has normally its lower end slightly eccentric or offset to the core 2 and the resilient block member 7 acts as a resilient fulcrum for the armature bar 5. The upper portion or tip 5*a* of the armature bar 5, emerging from the resilient block member 7, is engaged by suitable tolerance or play in the central hole or recess 10 of the blade holder 11 which is rigid with the razor head, as will be explained later. The holder is provided with downwardly projecting guides 12 designed to slidably engage a plate 13 provided at the top of cap 6 and integral therewith. On the holder 11 a rigid or flexible razor-blade 14 is provided, having a single or double cutting edge and is clamped between the upper surface of the holder 11 itself and the lower face of a blade cover element 15. The latter may be secured to the holder 11 through the knurled knob 16 which has an internal thread bore 17, screwable onto the cylindrical thread portion 18 of said blade cover element. A case 19 of plastics material is water tight screwable onto the support element 3 and forms a knurled handle for the razor. Case 19 protects also the winding of electromagnet 1.

The tapered end 20 of case 19 allows a water tight thermoplastic seal welding to the electric cable 21 terminating with the two-pole current plug 22, through which the electric energy required for operating the apparatus is derived from a socket. In FIG. 3 an additional resilient yieldable gasket 7*a* is shown, to improve the assembling of the component parts. FIGURES 6–9 show electric diagrams for the electromagnetic circuit, which is of the voltage changeover switch type since the winding of the electromagnet 1 is suitably dimensioned to handle all the voltages being distributed for domestic use at the frequency of 50 c.p.s. A voltage changeover 22*a* switch is preferably incorporated in the two-pole plug 22 instead in the case 19.

The circuit shown in FIG. 9 as well as the ring circuit shown in FIG. 8 are two modifications of the circuit shown in FIG. 1; such modifications involve, however, a larger amount of ferromagnetic material.

The magnetic circuit consists of materials conventionally used in the manufacturing of electric machines, that is: forge iron, silicon iron sheets, or orientated grain iron sheets, or particularly also a homogeneous or substantially homogeneous ferromagnetic single or composite ferrite. Such a ferrite can be represented by the formula MFe_2O_4, which can also be conceived as $MOFe_2O_3$, wherein M is a bivalent metal or a combination of two bivalent metals.

It should be noted that the composition need not to exactly satisfy the expression $MOFe_2O_3$. The quantities of MO and Fe_2O_3 may vary within such ranges that separation of a second crystalline phase, owing to which the magnetic properties are adversely affected, is avoided.

The method of the open magnetic circuit with flux loss, schematically indicated in FIGURE 7, has considerable advantages from a constructive point of view owing to its simplicity and, above all, as to its functional characteristics. As a matter of fact, the magnetic circuit, being of the flux loss type, allows to obtain elastic or yieldable oscillations having a constant frequency and an amplitude which is damped or modified depending on the mechanical resistance encountered by the movable cutting unit on shearing the beard hairs.

To understand the advantages of the present invention it is remembered that every single hair to be cut comprises three concentric organic layers. Furthermore, on an average there are on every sq. mm. from 6 to 10 hairs.

It is known that a cylindrical solid fixedly engaged at one end, as a beard hair may be, is subjected to simple shearing stress when any transverse cross-section is urged by a force lying in the plane thereof and passing through the centre of gravity. Thus, for example, a shearing stress will occur if a very sharp razor blade is caused to advance in the plane of the hair engagement or cutting section. The molecular reaction of the hair, in opposition to the sliding of a section relatively to another adjoining section, will lead to the shearing stress or inner tangential tension which, by using a razor according to the present invention, has reduced values. In fact, the shearing action performed on the hair by the apparatus according to this invention is accomplished by simultaneously imparting to the razor blade two component motions, of which the first, being a linear vibratory motion, operates as an alternative toothless saw at the engagement plane of the hair with an average speed of about 100 mm. per second. The second is the manual advancing motion being im-

parted by the operator. Even a third motion should be considered which consists of secondary vibratory motions of the blade. Such secondary vibrations are generated by the first motion due to the existing elasticity and clearances or play in the assembled component elements of the shaver. It occurs in the same plane as the said first motion but according to directions trasverse and even perpendicular to each other. Hence, the resulting motion is approximately a helicoidal zig-zag motion.

The results obtained by these three separate shearing motions simultaneously applied to a commercially available razor blade, allow a pleasing shaving owing to the relieved work conditions of the cutting edge, the usual operating life of which is thus considerably extended.

As a matter of fact, by means of the vibratory toothless sawing motion, the shearing stress decreases to a considerable extent and, therefore, also the inner tangential tension decreases according to the well known principles of mechanics. A very smooth shaving, completely at zero even with the most stiff, hispid and twisted beards, without any abrasion and absolutely lacking of skin inflammations may be obtained.

The shaver according to the invention operates as follows: on applying an appropriate voltage at 50 c.p.s. at the terminals of winding of the electromagnet **1** indicated in FIGURE 1 and through flexible cord **21** and plug **22**, said voltage will cause an alternate current to be circulated into said winding, which current will generate a magnetic flux also of the sine wave shape that will run through cores **2** and **5** with the same induction.

In the air gap **4***a* zone of space **4** the movable armature bar **5** is suitably eccentric with respect to core **2** by means of the resilient block member **7** and this elastic antagonism if desired, with the co-operation of a spring causes said armature bar **5** to vibrate in synchronism with the magnetic flux frequency. This vibratory motion is transmitted by the tip **5***a* of armature bar **5** to the reciprocating and vibratory razor head composed of holder **11**, razor blade **14**, cover blade element **15** and knurled screw **16**.

It should be evident that all of the vibrating elements of the system are dimensioned also in function of mass and elastic constants. Prior to effect shaving, it is necessary to apply an emmollient onto the face or to soap by means of a conventionl shaving-brush.

Many changes and modifications may be introduced to the embodiment shown in the drawing, without departing from the scope of the invention.

Thus for example in a further embodiment of the invention only the cutting razor blade was caused to reciprocate with respect to the head assembly, which was kept stationary, obtaining good shaving as in the previously described embodiment.

I claim:

1. In a reciprocating and vibratory electric razor having a casing, an electromagnet contained in said casing and a vibrating razor head, the combination comprising a hollow cap member coaxial with said casing and having one end thereof fixed on said casing, and the other end thereof having an opening and guide means for supporting and guiding the vibrating razor head, an elongated armature bar within said hollow cap member, responsive to the alternating magnetic field generated by said electromagnet, a resilient block member fixed within said hollow cap member near said other end thereof and adapted to provide a water proof closure of said opening thereof, said resilient block member having embedded therein an end portion of said armature bar remote from said electromagnet, said end portion of the armature bar having a tip projecting through said resilient block member and through said opening of said hollow cap member beyond said other end thereof, a recess in said razor head engagingly receiving said tip, said armature bar being arranged offset to the axis of said electromagnet in the rest position thereof, said resilient block member being adapted to urge said armature bar in its rest position, thereby to impart a reciprocating and vibratory motion to said armature bar when said electromagnet creates an alternating magnetic field and to transmit a reciprocating and vibratory motion to said razor head through said tip and said tip receiving recess thereof.

2. An electric razor according to claim **1**, wherein said guide means have guiding surfaces extending in the longitudinal direction of said razor head to allow reciprocating motion of said razor head in the longitudinal direction thereof, and said razor head has means providing a play between said guiding surfaces and said razor head to provide a vibrating motion in the direction transverse to the longitudinal direction thereof.

References Cited

UNITED STATES PATENTS

1,158,741	11/1915	Stearns	30—45
1,663,809	3/1928	Moon	30—45
1,813,630	7/1931	McCarty	30—45 X
1,832,961	11/1931	Barry	30—45
2,015,160	9/1935	Shaler	30—45
2,232,271	2/1941	Rider	30—45
2,301,552	11/1942	LaCell	30—45

FOREIGN PATENTS

1,016,485	8/1952	France.
1,185,200	2/1959	France.
611,919	10/1960	Italy.
191,063	5/1937	Switzerland.

WILLIAM FELDMAN, *Primary Examiner.*

MYRON C. KRUSE, *Examiner.*