Nov. 25, 1941. H. B. RANDOLPH 2,263,955

ELECTROMAGNETICALLY OPERATED MECHANICAL SHAVER AND LIKE CUTTING APPLIANCES

Filed April 20, 1938 2 Sheets-Sheet 1

Fig. 1.

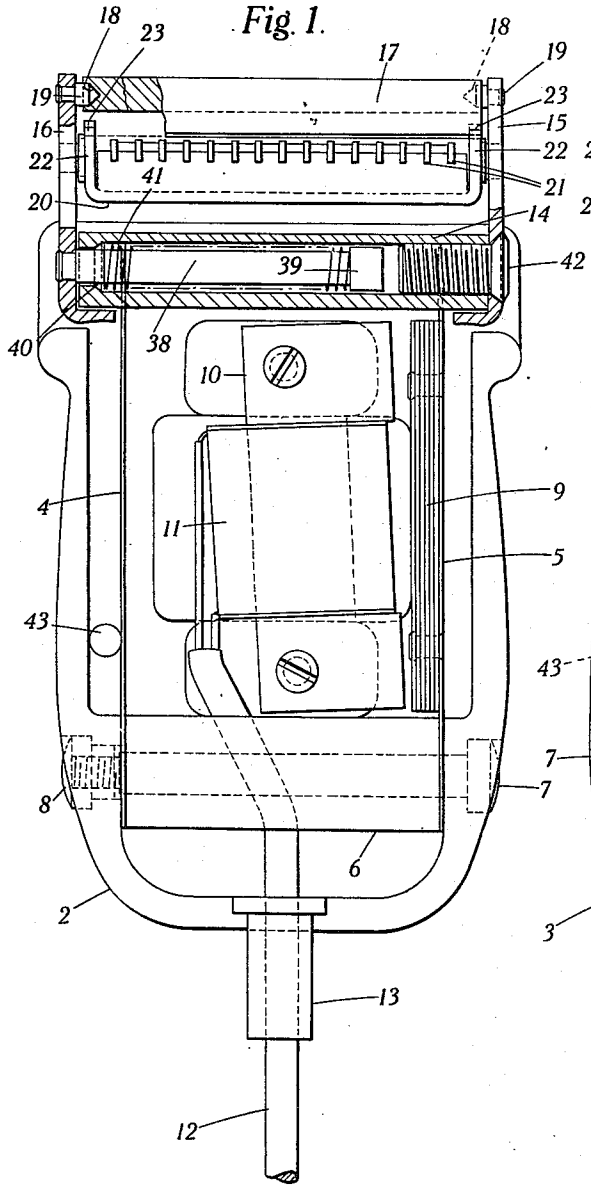
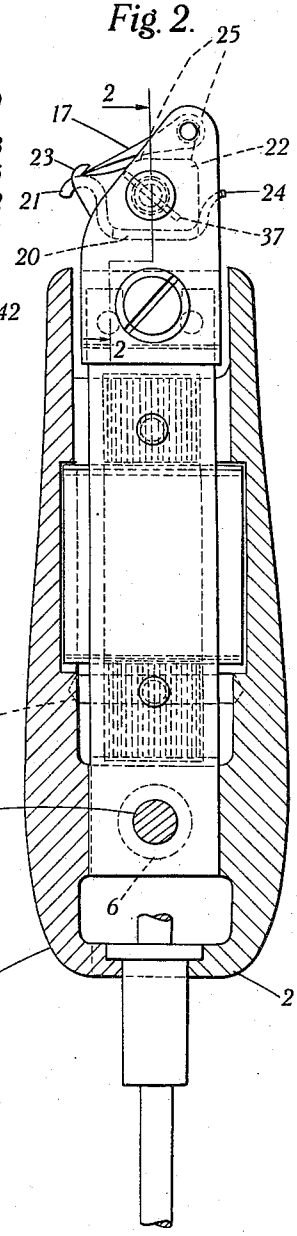


Fig. 2.



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Filed April 20, 1938 2 Sheets-Sheet 2

Fig. 3.

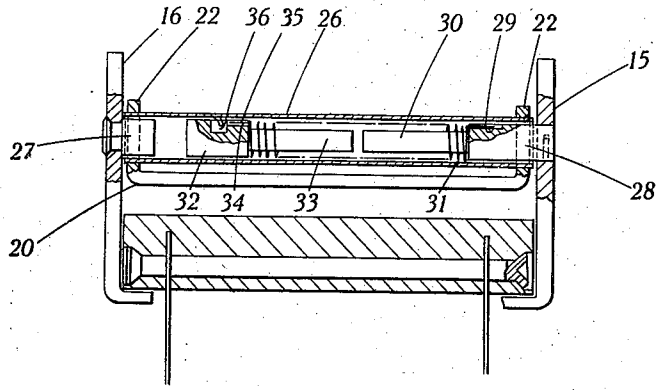


Fig. 4.

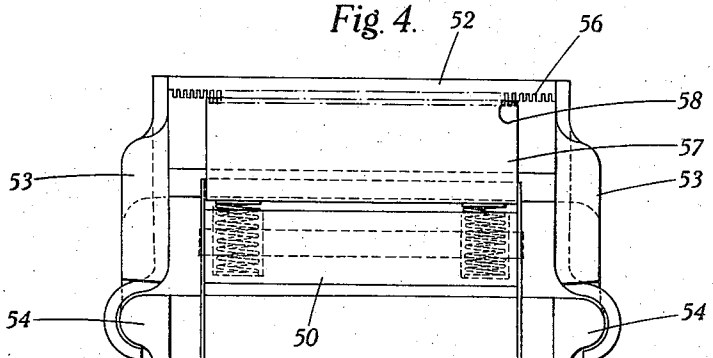
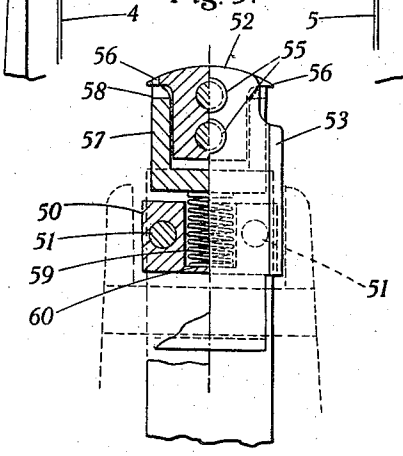


Fig. 5.



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ELECTROMAGNETICALLY OPERATED MECHANICAL SHAVER AND LIKE CUTTING APPLIANCES

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Application April 20, 1938, Serial No. 203,143
In Great Britain May 7, 1937

16 Claims. (Cl. 30—45)

This invention relates to improvements in electromagnetically operated mechanical shavers and like cutting appliances.

It has been proposed to vibrate a safety razor blade by an electro-magnet of which the armature actuates a mechanical device which moves the blade supported in guides in a direction parallel to the cutting edges. In one construction one limb of an electro-magnet is provided with a head or pin which moves the blade or taps the handle when vibrated by alternating or interrupted current.

Hair clipping machines of the kind adapted for shaving the beard without use of water and soap are generally actuated by some form of motor mechanism embodying spindles, pivoted levers and bearing surfaces introducing liability to wear and noise as well as necessitating lubrication, attention and adjustment.

As is known a leaf spring fixed at one end will vibrate at a high frequency when plucked at the free end. When the spring is loaded, for example, by a safety razor blade disposed in a plane at right angles to the direction of vibration a spring can be made to vibrate at a fairly high frequency and it is an object of the invention to utilise this phenomena in shavers and like cutting appliances.

It is a further object of the invention to provide an electric current actuated appliance comprising a cutting device carried upon a leaf spring fixed at one end and provided with an armature of an electro-magnet and to so arrange this system that its natural period of vibration coincides with the frequency of the alternating electric current energising the magnet so that resonance is obtained.

A particular object of the invention is to provide cutting appliances comprising a pair of leaf springs fixed at one end and carrying a cutting device upon the free ends, this arrangement being adapted to be actuated by an electro-magnet energised by alternating electric current the frequency of which coincides with that of the natural period of vibration of the spring supported system.

One object of the invention is to provide an alternating electric current actuated appliance having a tuned leaf spring supported razor blade capable of actuation by said current to improve the cutting action.

Another object is to provide means for supporting a razor blade in a novel form of holder permitting release of the blade to facilitate stropping thereof.

A further object is to provide an appliance of the dry shaver kind in which one of the clipping members is actuated by a leaf spring supported system, said system being tuned to resonate with the energizing alternating electric current.

A still further object of the invention is to provide adjustable means for facilitating the tuning operation of the above described vibratory systems and to secure said means in position when resonance is obtained.

Further objects and features of the invention will appear from the following description with reference to the accompanying drawings which show embodiments of the invention by way of example only and in which:

Figure 1 is a front view of a razor blade shaver with the cover of the handle shaped casing removed, part of the mechanism being shown in section.

Figure 2 is a side view of the shaver shown in Figure 1, showing the casing in section.

Figure 3 is a view of part of the mechanism shown in section and taken on line 2—2 of Figure 2.

Figure 4 is a front view of a clipper or dry shaver form of mechanism and

Figure 5 is a side view in half section of the mechanism shown in Figure 4.

A pair of leaf springs when fixed at one end and connected together at the other end, for example, by a cutting device can be vibrated by an alternating current energised magnet the poles of which face one of the leaf springs provided the spring is of magnetic material or is provided with an armature of such material.

When the electro-magnet in the above described arrangement is energised by alternating current the armature will be attracted to and repelled from the poles of the magnet at a frequency of reversals depending upon the frequency of the alternating current supply source. Such action will cause a slight movement of the leaf springs and of the cutting device but due to the inertia of the parts this is generally insufficient to move the cutting implement so as to improve the cutting action thereof to an appreciable extent. If, however, the natural period of vibration of the mechanical system coincides with the frequency of the alternating current the system will move in resonance therewith as the result of which the amplitude of movement of the cutter is greatly increased and an exceedingly effective cutting action is obtained.

The design and construction of appliances ac-

cording to the invention presents considerable difficulties principally due to the difficulty in mathematically determining the natural period of vibration of leaf spring supported systems such as the different types contemplated by the invention.

As the result of experiments it has, however, proved possible to design leaf spring supported mechanical systems so that they can be made to resonate with 50 cycle alternating electric current. If the frequency of the alternating current is 60 cycles the springs must be stiffer or shorter or alternatively the loading must be lighter. On the other hand if the frequency is 25 cycles the springs must be more resilient or longer or the loading may be heavier.

In the construction of appliances according to the invention the dimensions and quality of the leaf springs are proportioned to the mass of the cutting device and its mounting means, if any, and of any other part carried by the springs so that the natural period of vibration is approximately the same as the frequency of 50 cycle alternating current.

Owing to unavoidable differences in materials, manner of securing the springs and like causes it is not convenient to produce the appliances so that their characteristics are exactly identical and according to a feature of the invention an adjustable tuning device is provided by which means the system can be tuned to resonate with the alternating electric current without difficulty and when resonance is obtained the tuning device is fixed in position.

In order to facilitate manipulation by hand the above described arrangement is mounted in a casing in the form of a handle in which the leaf springs are rigidly secured at one end the cutting implement being disposed outside the casing so that the cutting edge or teeth are conveniently disposed for application to the beard or hair.

Referring to the drawings and to Figures 1, 2 and 3 in particular, numeral 2 denotes a metal or composition moulding or the like forming the casing for the mechanism of the shaver and 3 is a lid capable of being secured thereto so as to constitute with part 2 a handle shaped casing convenient in size for holding in the hand.

Lead springs 4 and 5 are anchored in the bottom of casing 2 by a spacing piece 6 and are secured to the casing by a bolt 7 having a nut 8 which bolt passes transversely through the casing and clamps the casing as well as the spring firmly. Springs 4 and 5 are of good quality spring steel and are between 2 and 3 inches long in the construction shown in the drawings being ½" wide and .020" thick. Spring 5 is provided with a plurality of magnetic material laminations 9 secured thereto by rivets or the like so as to constitute the armature of an electro-magnet the core 10 of which is secured in casing 2 by screws, bolts or the like. The energising winding 11 of the electro-magnet is connected to a twin electric cable 12 which passes through a rubber or like material gland 13 adapted to be clamped between casing 2 and lid 3.

The pole pieces of core 10 are spaced from the armature 9 so that forced vibrations do not cause the armature to strike the poles as this would cause chatter or noise which is highly objectionable in shavers during application to the face.

The cutting mechanism of the shaver shown in Figures 1, 2 and 3 incorporates a U shaped frame structure comprising bar element 14 and a pair of leg elements 15 and 16. The razor blade 17 is of the hollow ground type having a wide back in which holes 18 are produced said holes being engaged by correspondingly shaped pins 19 fixedly secured in legs 15 and 16.

The mechanism also incorporates a blade edge guard and holder comprising a flat plate portion 20 from which a comb guard provided with teeth 21 is bent up as indicated in Figures 1 and 2. The guard is also provided with end lugs 22 whereby the guard is pivotally secured to frame legs 15 and 16. The end lugs 22 are provided with hooks or claws 23 adapted to engage the ends of the blade edge so as to retain the blade edge and the guard teeth 21 in the position in which an effective cutting action can be obtained with the edge with a comparatively small risk of accidental cuts in accordance with the known safety razor guard principles.

In order to permit stropping of the edge of blade 17 the blade guard is provided with a manipulating handle 24 whereby the guard can be manipulated to free the hooks from the edge of the blade and the lugs 22 are provided with cam surfaces 25 arranged so that when the hooks are clear of the blade, cams 25 push the blade forward approximately into a horizontal position in the case of the mechanism shown in Figure 2.

Upon release of handle 24 the hooks 23 are spring urged against the side of the blade causing the same to be further rotated into a practically vertical position in the case of the mechanism shown in Figure 2 and the blade can in this position be inserted between stropping rollers or the like for the purpose of sharpening the edge and after the sharpening operation the blade 17 is pressed forward with the fingers causing the guard to pivot upon its support and to recede until hooks 23 snap over the ends of the blade edge after which the sharpened blade is in position for further use.

Referring to Figure 3 the pivotal support for the blade guard is shown as comprising a tube 26 to which lugs 22 are rigidly secured at the ends. Leg 16 is provided with a pivot pin 27 fixedly secured therein onto which one end of tube 26 fits with what may be termed sliding fit. Leg 15 is provided with another pivot pin 28 in which is formed a groove 29 and from which extends a reduced diameter portion 30 upon which a spring 31 is mounted the end of which passes into groove 29. To obtain anchorage for the other end 34 of the spring an element comprising a portion 32 having a sliding fit in tube 26 and a reduced section portion 33 is provided. The end 34 of spring 31 rests in a groove 35 in part 32 and a recess 36 is also produced therein into which a tongue or punched out projection on tube 26 is forced whereby parts 32 and 33 are rigidly secured in the tube to form a guide and anchorage for the end of spring 31.

Spring 31 is so arranged that tension can be applied thereto by pivot pin 28 to force hooks 23 into engagement with blade 17 with a predetermined pressure, pin 28 being finally locked in the desired position by means of a locking pin 37 shown in dotted lines in Figure 2. The length and character of spring 31 is such that the action of the edge guard previously described is obtainable and at the same time the blade 17 is held comparatively firmly as is required for shaving purposes.

In order to facilitate removal of blade 17, Figures 1 and 2, and substitution of another blade,

leg 16 is resiliently secured to bar 14 by means of a pin 38 having a head 39 the arrangement as shown in Figure 1 being such that a spring 40 resting against head 39 and against a reduced portion of an orifice 41 in bar 14 tends to retain pivot pins 19 firmly forced into holes 18 in blade 17. By pulling leg 16 against the action of spring 40, pins 19 can be withdrawn from holes 18 whereby blade 17 is freed, pivot pin 27 (Figure 3) being pulled somewhat out of the end of tube 26 to permit displacement of leg 16. When a new blade has been inserted between pins 19, spring 40 restores the mechanism to the position shown in Figure 1 firmly clamping the blade in position. In order to permit insertion of pin 38 in orifice 41 a screwed stud 42 is screwed into said orifice, said screw at the same time serving to secure leg 15 to bar 14 in a rigid manner.

The mechanism described above will vibrate when magnet 11 (Figure 1) is energised with 50 cycle alternating current but experience shows that it is extremely difficult to ensure that springs 4 and 5 when mounted and loaded with the mechanism in the manner described above will necessarily have a natural period of vibration of 50 cycles per second which is necessary in order that the system may resonate when magnet 11 is energised. To overcome this difficulty springs 4 and 5 are made slightly longer than is necessary for obtaining resonance under the conditions described and an adjustably mounted tuning element 43 is forced between spring 4 and the side of casing 2 and is adjusted until the springs, when loaded as indicated, vibrate in resonance with the alternating electric current. Resonance is obtained when springs of the dimensions described and mechanism of the proportions with respect to the springs shown in the drawings are adopted. Tuning operation is very easily carried out by sliding element 43 up and down and when the system is not in resonance a comparatively slight movement is imparted to the blade 17 but as soon as resonance is approached the amplitude of vibrations increases to a very pronounced extent and further movement of element 43 will again cause the system to be thrown out of tune after which the vibrations will again become of very restricted amplitude. Normally the distance over which the element 43 can be moved is of the order of ⅛" and the exact tuning point is obtained by selecting the centre of the distance over which resonance appears to be obtained. When this position has been determined holes are produced in the bottom of casing 2 and in lid 3 so that element 43 will be firmly held in position when the lid 3 is secured to casing 2 by screws or other suitable means.

The application of the invention to hair clippers or devices known as dry shavers is shown in Figures 4 and 5. Springs 4 and 5 in this case are secured together at the free end by a distance bar or piece 50 secured to the springs by rivets or the like 51 the ends of springs 4 and 5 projecting a short distance above the top of bar 50 as shown in Figure 4.

The cutter 52 is T shaped and is secured by means of fairly rigid struts 53 to beads 54 upon casing 2 the cutter and struts being rigidly secured together by rivets or the like 55. The cutter is provided with fine teeth 56 with which a movable U shaped cutter 57 provided with teeth 58 cooperates.

As shown in Figure 4 movable cutter 57 fits between the ends of springs 4 and 5 and a pair of springs 59 housed in holes 60 in bar 50 are arranged to push the teeth 58 of the movable cutter 57 onto the teeth 56 of the stationary cutter 52.

The magnetic system as well as the mounting casing for the mechanism shown in Figures 4 and 5 are identical to that shown in Figures 1 and 2 and it will be appreciated that when springs 4 and 5 loaded as indicated in Figures 4 and 5 are tuned to resonate with the alternating electric current the teeth of the movable cutter will reciprocate with respect to the teeth of the stationary cutter and will produce a clipping action which, as is known, can be utilised for shaving provided the teeth 56 are sufficiently fine.

The electro-magnetic system of the present invention is of extreme simplicity and experience indicates that by obtaining resonance of the mechanical vibratory system with the energising current amplitudes of movement of the cutting device of up to ⅛" are easily obtainable. In the case of blade shavers such movement is actually not desirable and a movement of the order of 1/32nd" is preferred but it will be understood that this is somewhat reduced when the blade is applied to the face. Stopping of the blade by contact with the face is not possible provided the system resonates and an exceedingly effective cutting action is obtained by the blade shaver shown in Figures 1 and 2.

In clipper or dry shaver devices of the kind shown in Figures 4 and 5 it is highly desirable to obtain movement in excess of a space corresponding to the width of a tooth upon the movable cutter as well as the space between adjacent teeth and owing to the liability to reduction in amplitude of vibration a somewhat more powerful electro-magnetic system is required for dry shavers than is necessary for blade shavers.

By reducing the weight carried by the springs 4 and 5 an increase in amplitude is obtained and for this purpose the spacing bar 50 is preferably of light metal alloy and moreover the section of cutter 57 is reduced to the minimum necessary for adequate mechanical rigidity and in this manner amplitudes of the order of ⅛" are obtained such amplitude being reduced to about half when cutting through stiff beard or dense hair but under normal practical conditions the clipping action remains effective under ordinary clipping and shaving conditions.

The appliance has exceptional advantages over rotor actuated appliances for use as a power unit in shavers and hair clippers owing to its extreme simplicity, absence of mechanical mechanism and frictional effects. Moreover it is silent in operation and extremely durable whereas the appliance lends itself to production upon a large scale at low cost compared with other forms of power units for similar purposes.

Various changes may be made in the specific embodiments of the invention herein described without departing from or sacrificing the advantages of the invention as defined in the appended claims.

I claim:

1. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system comprising of a pair of leaf springs positioned in spaced relation, one on each side of said electromagnet, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a cut-

ting device attached to the other ends of said leaf springs, an armature disposed centrally on one of said leaf springs between said base and said cutting device so as to face the poles of said electromagnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

2. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs positioned in spaced relation, one on each side of said electromagnet, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a cutting device attached to the other ends of said leaf spring, an armature consisting of a plurality of laminations of magnetic material disposed centrally on one of said leaf springs between said base and said cutting device so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

3. A cutting appliance comprising: an alternating electric current electro-magnet, a leaf spring vibratory system for said electro-magnet, a supporting base for said leaf spring vibratory system, means for fixing one end of said leaf spring vibratory system to said supporting base, a cutting device attached to the other end of said leaf spring vibratory system, an armature disposed centrally on one of the leaf springs of said vibratory system between said base and said cutting device so as to face the poles of said electro-magnet, said leaf spring vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained and means for tuning said vibratory system by lengthening or shortening the effective vibratory portion of one of the leaf springs of said vibratory system.

4. A cutting appliance as set forth in claim 3, having means for permanently fixing said tuning means after the vibratory system is tuned.

5. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a spacing member attached to the other ends of said leaf springs, a cutting device attached to said spacing member, an armature disposed centrally on one of said leaf springs between said base and said spacing member so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

6. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a spacing member attached to the other ends of said leaf springs, a leg member rigidly attached to one end of said spacing member, another leg member resiliently secured to the other end of said spacing member, a razor blade adapted to be supported between said leg members, an armature disposed centrally on one of said leaf springs between said spacing member and said supporting base so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

7. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a spacing member attached to the other ends of said leaf springs, a leg member rigidly attached to one end of said spacing member, another leg member resiliently secured to the other end of said spacing member, a razor blade pivotally supported between said leg members, an armature disposed centrally on one of said leaf springs between said base and said spacing member so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

8. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a spacing member attached to the other ends of said leaf springs, a leg member rigidly attached to one end of said spacing member, another leg member resiliently secured to the other end of said spacing member, a razor blade pivoted to said leg members, means for limiting the pivotal movement of said razor blade, an armature disposed centrally on one of said leaf springs between said base and said spacing member so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

9. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a spacing member attached to the other ends of said leaf springs, a leg member rigidly attached to one end of said spacing member, another leg member resiliently secured to the other end of said spacing member, a razor blade pivoted between said leg members, a guard for said blade edge, spring urged hooks for said guard, said hooks being adapted to engage the ends of said blade edge, an armature disposed centrally on one of said leaf springs between

said base and said spacing member so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

10. A cutting appliance as set forth in claim 9 having pivot pins secured to said leg members for supporting said guard, and a spring attached to one of said pins and to said guard for normally urging said guard hooks into engagement with the ends of said blade edge.

11. A cutting appliance as set forth in claim 9 having pivot pins secured to said leg members for supporting said guard, a spring attached to one of said pins and to said guard for normally urging said guard hooks into engagement with the ends of said blade edge, finger actuated means for disengaging said guard hooks from said blade edge, and cam means for moving said blade about its pivots.

12. A cutting appliance as set forth in claim 9 having pivot pins secured to said leg members for supporting said guard, a spring attached to one of said pins and to said guard for normally urging said guard hooks into engagement with the ends of said blade edge, finger actuated means for disengaging said guard hooks from said blade edge, and means for moving said blade on its pivots into stropping position upon release of said finger actuated means.

13. A cutting appliance as set forth in claim 9 having pivot pins secured to said leg members for supporting said guard, a spring attached to one of said pins and to said guard for normally urging said guard hooks into engagement with the ends of said blade edge, finger actuated means for disengaging said guard hooks from said blade edge, and means for moving said blade on its pivots into stropping position upon release of said finger actuated means and back into engagement with said guard hooks by the application of finger pressure to said blade.

14. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a T-shaped hair clipper cutter supported over the free ends of said springs, a U-shaped sliding cutter associated with said T-shaped cutter and attached to the free ends of said springs, an armature disposed centrally on one of said leaf springs between said base and said U-shaped cutter so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

15. A cutting appliance comprising: an alternating electric current electro-magnet, a vibratory system for said electro-magnet, said vibratory system consisting of a pair of leaf springs, a supporting base for said leaf springs, means for fixing one end of each of said leaf springs to said supporting base, a spacing member attached to the other ends of said leaf springs, a U-shaped cutting device, a T-shaped cutter carried by said supporting base and associated with said U-shaped cutting device, spring means carried by said spacing member and engaging said U-shaped cutting device for pressing it into engagement with said T-shaper cutter, an armature disposed centrally on one of said leaf springs between said base and said spacing member so as to face the poles of said electro-magnet, said leaf spring supported vibratory system as a whole being arranged to have a natural period of vibration substantially coinciding with the frequency of the alternating current energizing said electro-magnet so that resonance is obtained.

16. A cutting appliance comprising: an electro-magnet adapted to be energized by pulsating electric current having a definite frequency, a cutting device, a vibratory system actuated by said electromagnet, said vibratory system consisting of a leaf spring for substantially floatingly supporting one end of said cutting device and for driving said cutting device, a supporting base for said leaf spring, means for rigidly fixing one end of said leaf spring to said supporting base, said vibratory system including additional supporting means for flexibly and substantially floatingly supporting the other end of said cutting device on said base, and an armature disposed centrally on said leaf spring between said base and said cutting device so as to face the poles of said electromagnet, said vibratory system and said cutting device as a whole having a natural period of vibration substantially coinciding with the frequency of the pulsating current energizing said electro-magnet so that resonance is obtained.

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