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(54) **VIBRATOR MOTOR**

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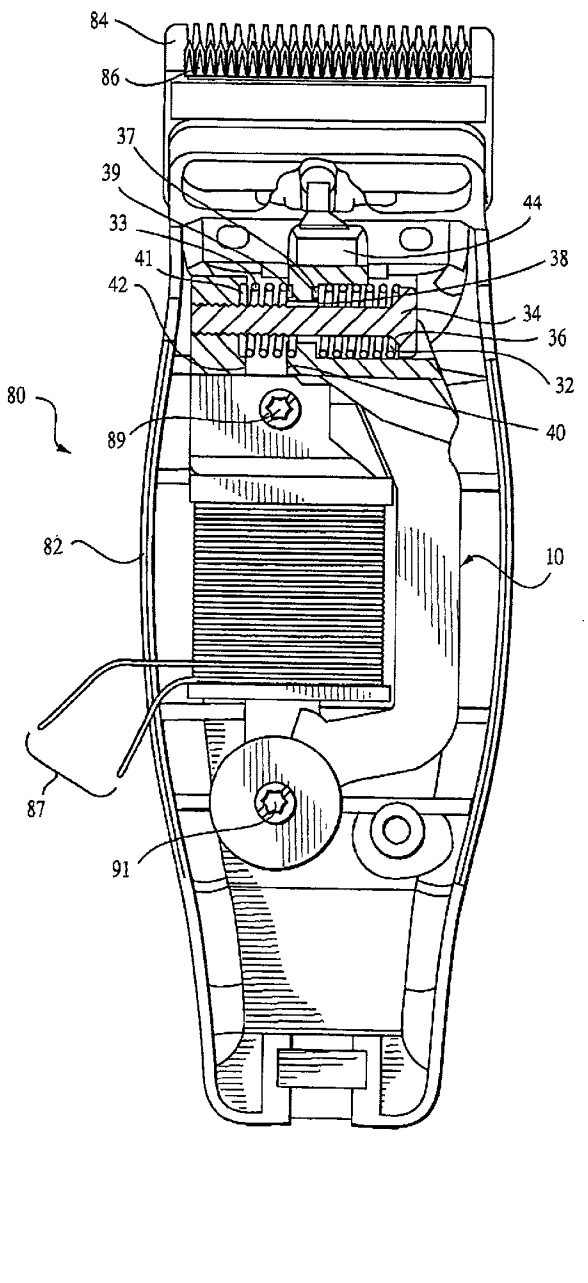
(57) **ABSTRACT**

A vibrator motor has a stationary piece and a moving piece hinged at one end. The moving piece does not generate substantial internal spring forces under the influence of an electromagnetic field, because it does not have a tail bracket. Other parts of conventional motors are also eliminated, so the motor is easier and less expensive to manufacture. In addition, the motor can be assembled and tuned before installation, which increases the ability to automate assembly.



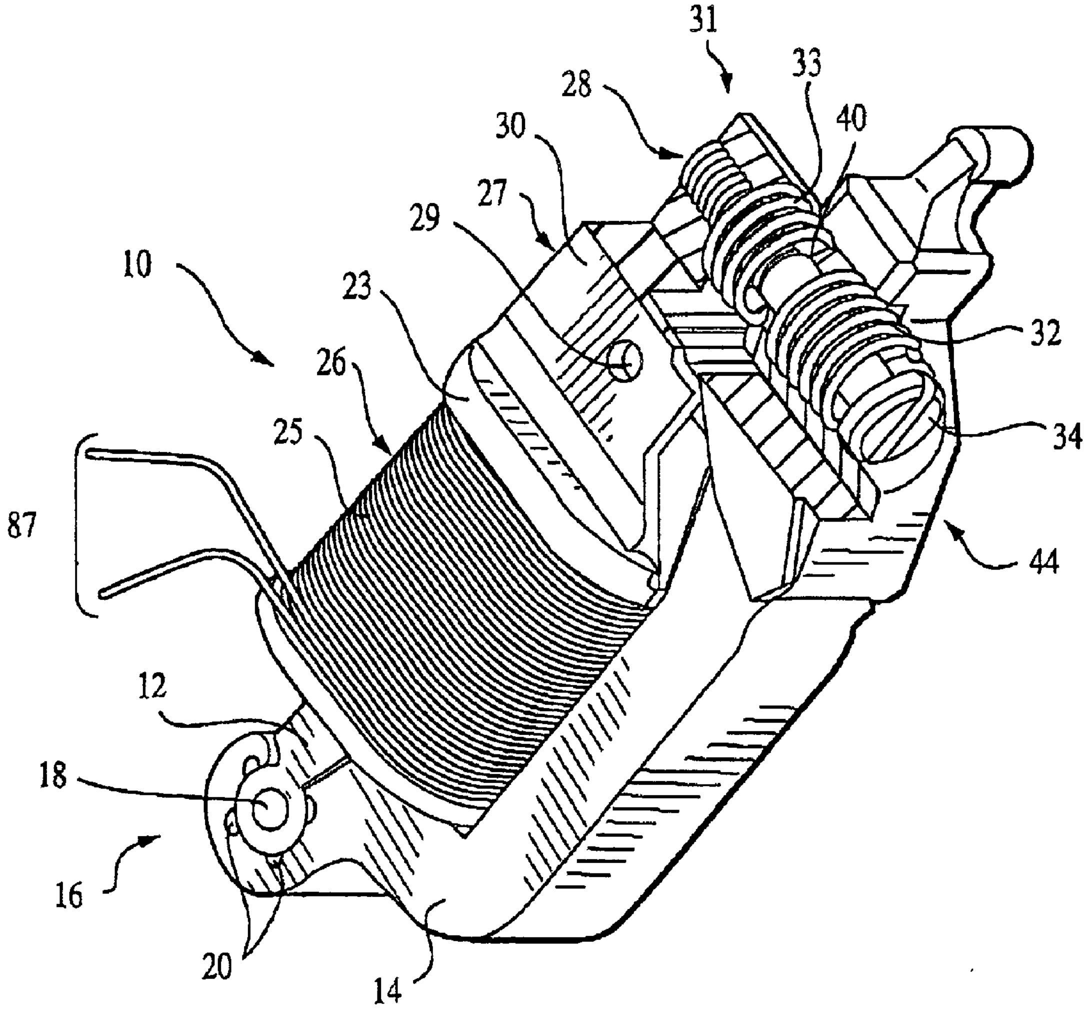


FIG. 1

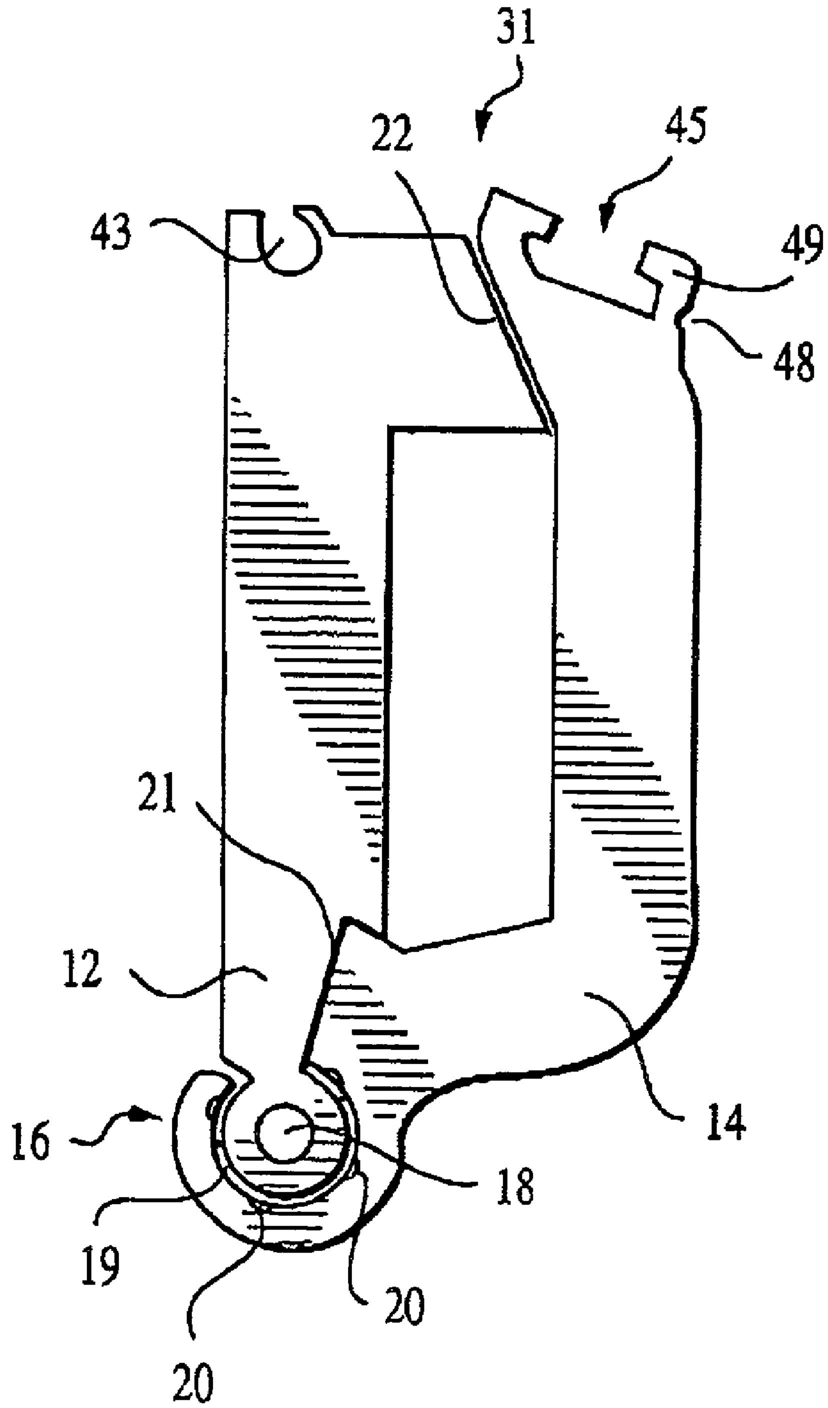


FIG. 2

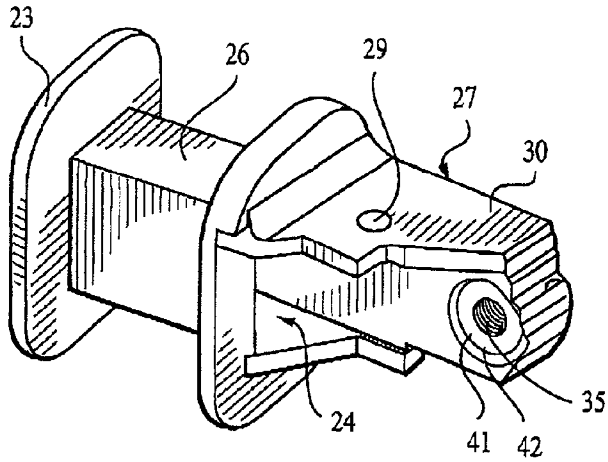


FIG. 3

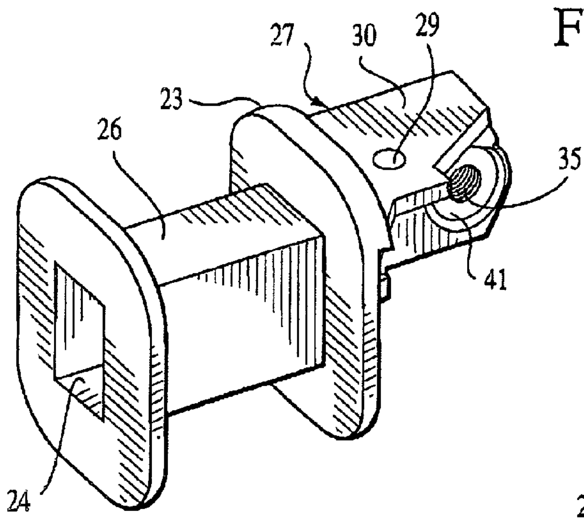


FIG. 4

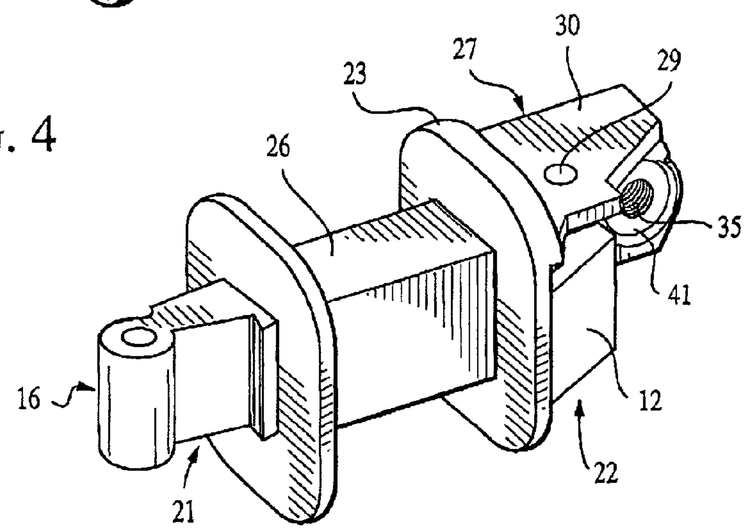


FIG. 5

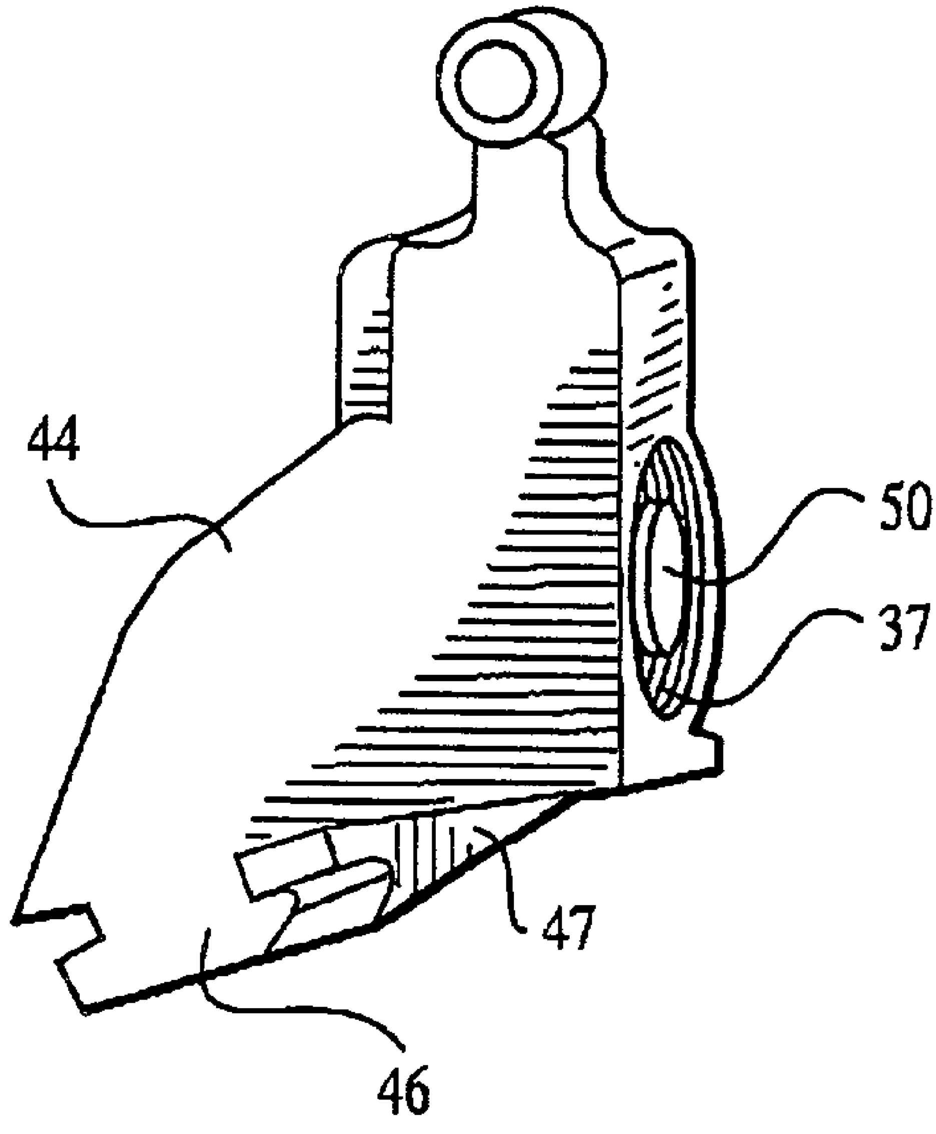


FIG. 6

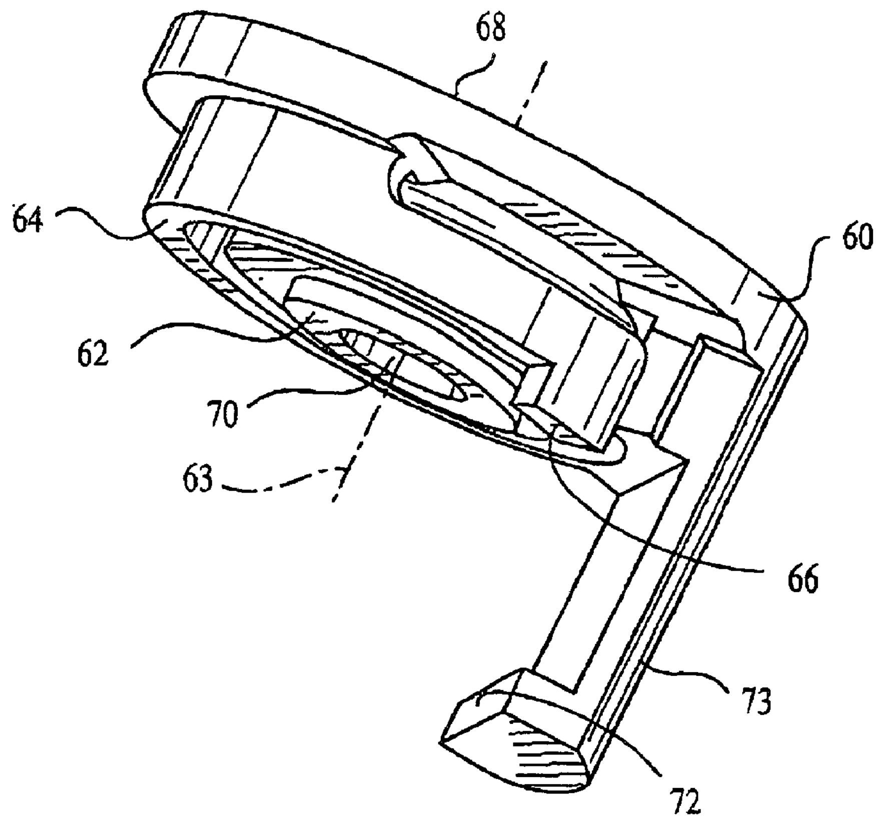


FIG. 7

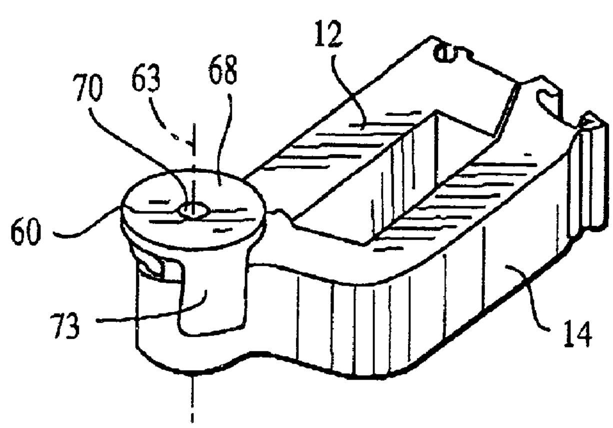


FIG. 8

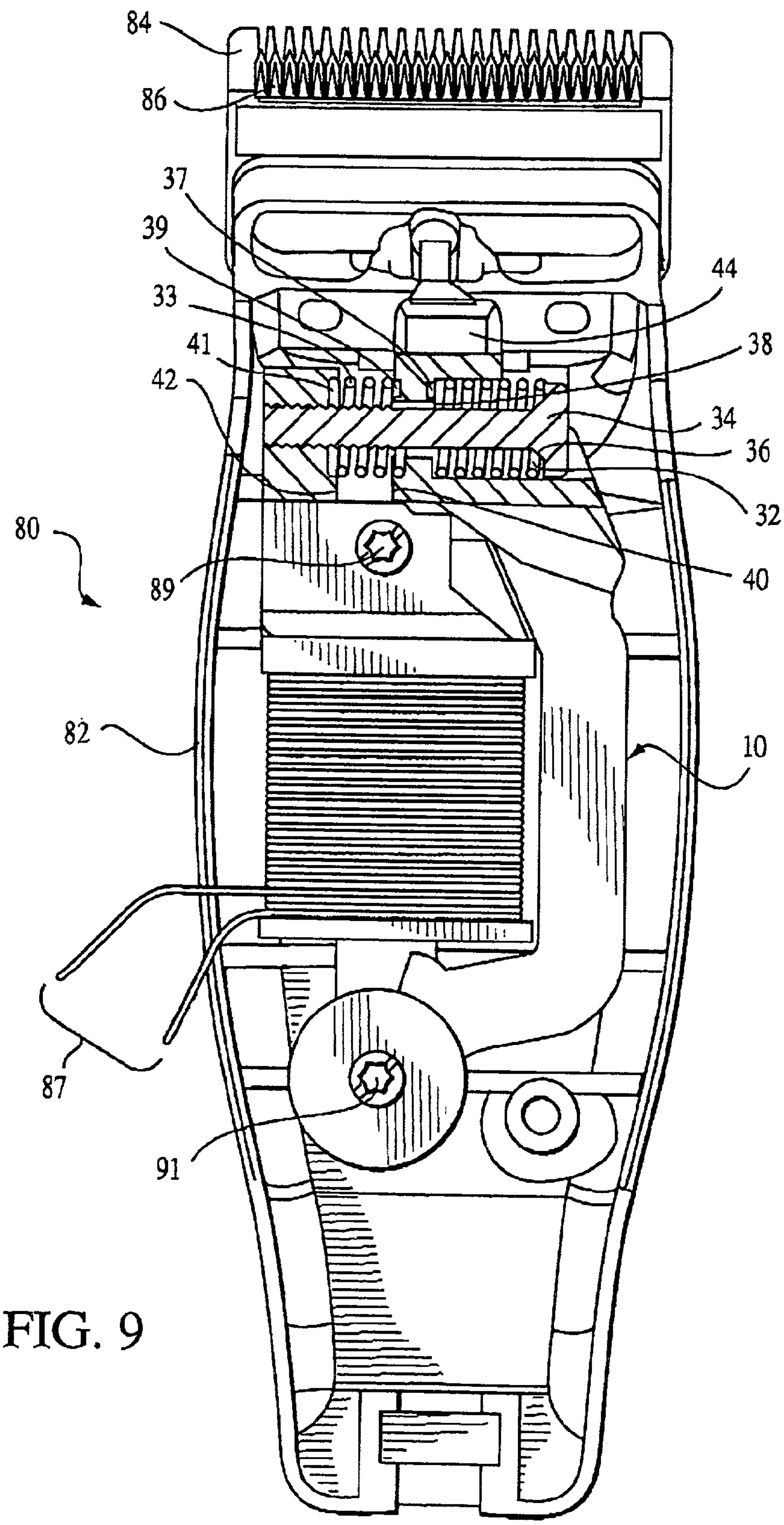


FIG. 9

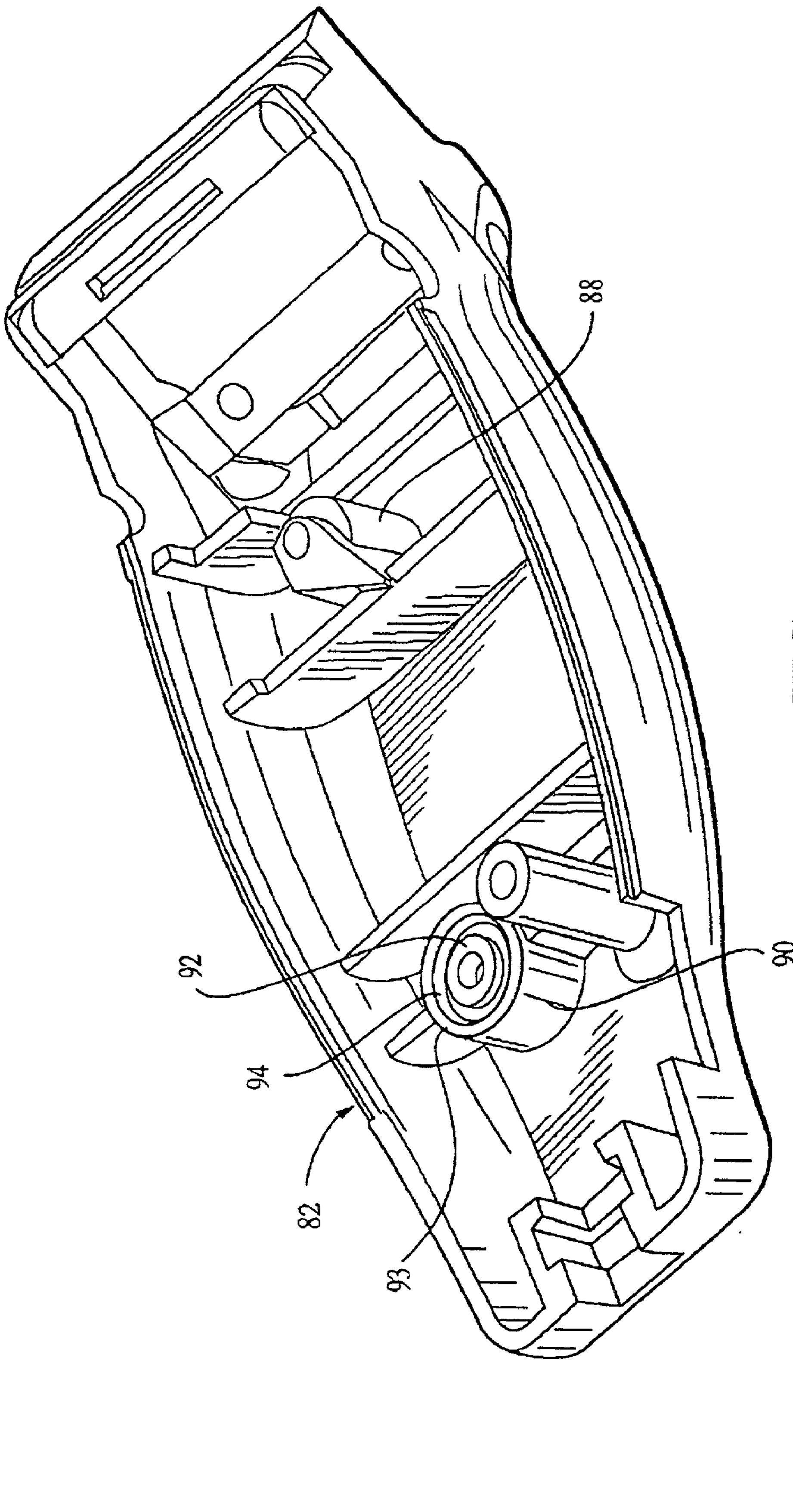


FIG. 10

VIBRATOR MOTOR

[0001] This invention relates to vibrator motors, and more particularly to vibrator motors for hair clippers and the like that have fewer parts than conventional vibrator motors, and can be installed in a case after the motor is assembled.

BACKGROUND OF THE INVENTION

[0002] Vibrator motors are available in a variety of configurations. Typically, the motor includes a stack of stationary laminations secured inside a case for a hair clipper or other device. A coil wrapped around the stationary laminations produces varying electromagnetic fields that drive a complimentary set of moving laminations.

[0003] The moving laminations are typically secured in an appropriate location with respect to the stationary laminations using a spring-like tail bracket. At least one, and usually two or three, pole faces are formed where the stationary and moving laminations are close to each other. One end of the tail bracket is secured to an end of the moving laminations, and the other end of the tail bracket is secured to the housing or the stationary laminations. The tail bracket/moving laminations assembly forms an arm of sorts that is attached at one end and open at the other. The open end of the moving laminations reciprocates to drive a clipper blade or some other device.

[0004] In addition to the tail bracket, conventional vibrator motors also have a mechanical spring system that allows the motor to be tuned to a proper resonant frequency so that it operates properly. The spring system also determines the position of the moving laminations and clipper blades when the coil is not energized. A typical spring system has two coil springs. When the coil is energized by alternating current, the tail bracket, the spring system and the electromagnetic fields generated by the coil make the clipper blade or other device reciprocate. Motor tuning is accomplished by adjusting the stiffness of the springs in the spring system to obtain good performance, usually by turning an appropriate screw which adjusts the tension in the springs. If not properly tuned the motor will not have sufficient power, or it will flutter or clatter and essentially operate in an uncontrolled manner or not operate at all.

[0005] Many things affect tuning, including the weight of the moving parts, the weight of the stationary parts, the length of the moving part of the arm, the energy release rate of the tuning springs, the alignment of the pole faces, the stiffness of the tail bracket, and other factors. Variations in any of these aspects of the device can cause problems in operation, and problems in manufacturing and assembly.

[0006] Variations in the tail bracket present particularly difficult manufacturing challenges. If the tail bracket material thickness or hardness varies even slightly, the resonant frequency (the speed at which the arm vibrates naturally) is affected, since the force required to move the arm is related to the stiffness of the tail bracket. Even variations in bends in the tail bracket can cause assembly problems, because they can make the motor untunable.

[0007] The tail bracket acts as a secondary tuning spring in addition to the two coil type tuning springs. If the neutral unsprung position of the tail bracket in the assembly is not the same as the neutral position of the arm when the clipper has been tuned, the tail bracket works against one of the tuning springs, applying a heavier load to one of the tuning springs than to the other. This causes the resonant frequency to change, since the spring load changes in order to compensate for the bias load applied by the tail bracket. Moreover, the force required to move the arm also varies under these conditions. Variations in tail bracket bends also affect the orientation of the blades, and in some cases make it difficult to properly align the blades of hair clippers.

[0008] Another problem with known vibrator motors is that they require several pieces that must be assembled together in the case. The case is usually molded from plastic, which can have substantial dimensional variation due to warping and dimensional variation inherent in the molding process. These variations can create manufacturing and assembly problems.

[0009] Dimensional variations of the pieces assembled in the case can create additional manufacturing and assembly problems. For example, if the drive finger is the wrong length, it can cause tuning problems due to the change in resonant frequency caused by a change in the length of the arm. In hair clippers, a drive finger that is too long can make it impossible to align the tips of the bottom blade teeth with the tips of the top blade teeth so that they have the correct overlap distance. If the drive finger is crooked, it can cause a crooked appearance of the top blade. If the drive finger is too far to the right or left, the teeth of the bottom blade might not be able to be adjusted to line up with the top blade teeth, causing a loss of cutting performance.

[0010] Dimensional variations can also cause misalignment of the pole faces of the stationary and moving laminations. If there is excessive variation in the case, and/or in the arm assembly, the pole faces of the arm laminations will not be aligned with the pole faces of the coil laminations. There can be a vertical misalignment or the laminations can be twisted such that there may be a larger gap between poles near the top than at the bottom, or vice versa. Also, one of the poles may be closer together than the other poles. In any of these cases, the motor will not operate as efficiently as if the poles were well aligned, because the magnetic gap will be larger than it should be at some place, resulting in loss of power and/or efficiency or higher than normal power consumption.

[0011] These problems can occur when one part, such as the case, is out of tolerance, or when the parts are individually within acceptable tolerances, but the cumulative variations from desired specifications is unacceptably high. Tolerance accumulation problems are often difficult to identify and resolve, particularly where the number of parts is high.

[0012] In some conventional motors, the tuning springs are located at the rear or bottom of the motor, away from the drive end of the arm. This can also cause tuning problems, because the springs have poor leverage.

[0013] In all, conventional motors have a relatively high number of parts which make them expensive and difficult to manufacture and assemble. Automation is also difficult because the designs are fairly complicated. Accordingly, there is a need for vibrator motors that are easier to manufacture and assemble, and are more adaptable to automated manufacture and assembly.

[0014] Accordingly, one object of this invention is to provide new and improved vibrator motors.

[0015] Another object is to provide new and improved vibrator motors for hair clippers and the like.

[0016] Another object is to provide new and improved vibrator motors that are less expensive and easier to manufacture and assemble than conventional motors.

[0017] Yet another object is to provide new and improved vibrator motors that do not have a tail bracket or the problems associated with tail brackets just discussed. A still further object is to provide new and improved vibrator motors that are less susceptible to parts tolerance build-up.

[0018] Still another object is to provide new and improved vibrator motors having fewer parts than conventional motors.

[0019] Still another object is to provide new and improved vibrator motors that can be pre-assembled and installed in a case after assembly.

SUMMARY OF THE INVENTION

[0020] In keeping with one aspect of this invention, a vibrator motor has a stationary piece and a moving piece. One end of the moving piece is hinged to an end of the stationary piece. The pieces are open at the other end, where complementary pole faces on the stationary and moving pieces are separated from each other by at least one predetermined variable gap. Another gap is typically provided near the hinge, and other gaps may be provided, if desired.

[0021] A coil is wound around a bobbin on the stationary piece. When the coil is energized with alternating current, it generates magnetic flux that flows through the stationary piece and the moving piece. The flux crosses the gap just above the hinge, as well as the gap at the other end of the motor pieces.

[0022] A bias spring system plays the primary role in establishing the size of the gap between the stationary and moving pieces, and the resonant frequency of the motor during operation. The bias on the spring system can be adjusted to obtain an acceptable gap and resonant frequency. An extension on the bobbin and a drive member on the moving piece provide support for the spring system.

[0023] The open vibrating end of the moving piece has sufficient power to drive a device such as the moving blade of a hair clipper or the like. The entire motor can be assembled and installed in a case as a single unit. In fact, the motor can even be tested and tuned outside of the case, before installation, if desired.

[0024] The moving piece is hinged directly to the stationary piece without a tail bracket, and the moving piece does not generate substantial internal spring forces under the influence of the magnetic field. The tail bracket and other parts of conventional motors are eliminated entirely, and the motor is less expensive to manufacture. It is also easier to manufacture and assemble because it has fewer parts, less cumulative tolerance among parts, and a simpler system for establishing the resonant frequency. In addition, the motor can be assembled and tuned before installation, which increases the ability to automate assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The above mentioned and other features of this invention and the manner of obtaining them will become more apparent, and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, in which:

[0026] **FIG. 1** is a partially cutaway perspective view of a vibrator motor made in accordance with the principles of this invention;

[0027] **FIG. 2** is a plan view of the stationary and moving pieces used in the motor of **FIG. 1**;

[0028] **FIGS. 3, 4** and **5** are perspective views of a coil bobbin used in the motor of **FIG. 1**, with **FIG. 5** showing the stationary piece installed in the bobbin;

[0029] **FIG. 6** is a perspective view of a drive member used in the motor of **FIG. 1**;

[0030] **FIG. 7** is a perspective view of a hinge holder for the motor of **FIG. 1**;

[0031] **FIG. 8** is a perspective view of the pieces of **FIG. 2**, showing the moving piece retained to the stationary piece by the holder of **FIG. 7**;

[0032] **FIG. 9** is a plan view of the motor of **FIG. 1** installed in a hair clipper; and

[0033] **FIG. 10** is a perspective view of the case of the hair clipper of **FIG. 9**.

DETAILED DESCRIPTION

[0034] As seen in **FIGS. 1 and 2**, a vibrator motor **10** includes a stationary piece **12** and a moving piece **14**. The pieces **12**, **14** can be made of a plurality of stacked laminations, or solid material.

[0035] The stationary piece **12** and the moving piece **14** form a hinge **16** at one end. Hinging can be accomplished in many ways. In **FIGS. 1 and 2**, the hinge end of the stationary piece **12** is circular on an outer surface, like a hinge pin, with an opening **18** for an installation screw, as will be seen. The hinge end of the moving piece **14** is curved on an inside surface to at least partially surround the curved portion of the stationary piece **12** and form a hinge barrel. Preferably, clearance between the pieces in the hinge is as minimal as possible, while still allowing the moving piece **14** to rotate in operation.

[0036] The hinge **16** may be lined with plastic **19** (**FIG. 2**) or any other suitable low friction material, if desired, to reduce wear and dissipate heat, if desired. Grease slots **20** may be provided in the moving piece **14**, as in **FIG. 1**, or in the stationary piece **12**. Though not shown, it is contemplated that the hinge **16** could also be made by providing the moving piece **14** with a hinge pin and the stationary piece **12** with a hinge barrel.

[0037] When assembled, the motor **10** has two gaps **21**, **22** (**FIG. 2**) between the stationary piece **12** and the moving piece **14**. While the embodiment shown in **FIGS. 1 and 2** has a generally L shaped stationary piece and two gaps, other configurations are possible, such as a C shape with two gaps, an E shape with three gaps, etc. The surfaces that form the gaps **21**, **22** are pole faces. Preferably, the pole faces of the gap **21** form a plane that generally intersects the axis of the opening **18**.

[**0038**] The motor **10** also includes a coil bobbin **23** (**FIG. 3**) having an opening **24** (**FIG. 4**) that allows the bobbin **23** to be placed around the stationary piece **12** by slipping the bobbin over the hinge end **16** of the stationary piece **12**, as seen in **FIG. 5**. A coil **25** (**FIG. 1**) is wound around a winding portion **26** of the bobbin **23**, preferably before installation. In some products, such as massagers, the coil can be wound around the moving piece instead of the stationary piece.

[**0039**] The bobbin **23** also has an arm **27** used to support a movement control device such as a spring system **28** (**FIG. 1**). A screw hole **29** is also provided for motor installation purposes. The screw hole **29** preferably goes through a bobbin gusset **30**, adding rigidity to the arm when assembled in the case. The bobbin **23** can be made in many ways, but is preferably molded in the one piece configuration shown in **FIG. 1**.

[**0040**] The spring system **28** (**FIG. 1**) is located toward an open end **31** of the stationary piece **12** and the moving piece **14**. The spring system **28** determines the position of the moving piece **14**, and plays a part in determining the resonant frequency of the moving piece **14** and the amplitude of its vibrations during operations. The spring system **28** includes a first spring **32**, a second spring **33**, and an adjusting screw **34** that threadedly engages an opening **35** in the bobbin **23**. The screw **34** preferably has a chamfer **36** (**FIG. 9**) that limits lateral movement of the spring **32**, and a groove **37** in a wall **38** also limits lateral movement of the spring **32**. Lateral movement of the spring **33** is limited by a groove **39** in a wall **40** and a groove or indentation **41** in a wall **42**.

[**0041**] The end of the stationary piece **12** at the open end **31** has an opening **43** that aligns with the opening **29** in the bobbin **23** for installation purposes. The end of the moving piece **14** at the open end **31** is configured to accept and secure a drive member **44** (**FIG. 6**). Using a C shaped end configuration **45** shown in **FIG. 2**, and a T shaped end configuration **46** for the drive member **44**, as shown in **FIG. 6**, the drive member can be easily secured to the open or moving end of the piece **14** by slipping the end **46** into end **45** up to a side wall **47**. A notch **48** (**FIG. 2**) facilitates bending or crimping of an end **49** of the moving piece **14**, to more tightly secure the drive member **44** to the moving piece **14** after installation. It is also contemplated that the drive member **44** and the moving piece **14** could be fabricated as one piece. In any event, the drive member is on the moving piece.

[**0042**] The screw **34** (**FIG. 1**) passes through an opening **50** (**FIG. 6**) in the drive member **44**. The spring **32** (**FIG. 1**) is held under tension between the head of the screw **34** and the wall **38** of the drive member **44**. Tension is maintained in the spring **33** by the wall **40** in the drive member **44** and the wall **42** in the arm **27** of the bobbin **23**. The arm **27** is threaded to secure the screw **34** in place, while allowing easy adjustment of the screw **34** for tuning purposes.

[**0043**] The moving piece **14** can be secured with respect to the stationary piece **12** at the hinge **16** in any suitable way, such as a screw and a washer, or a screw and a holder **60**, shown in **FIGS. 7 and 8**. The holder **60** has a bottom surface **62** that rests on the stationary piece **12** surrounding the opening **18** to secure the stationary piece **12** axially with respect to an axis **63**, a second surface **64** having a surface **66** on a flexible, resilient finger that holds the moving piece **14** down and in proper alignment with the stationary piece **12**, and a top surface **68** by which the holder **60** can be held in place. By allowing the surface **66** to function independently of the surface **62**, the hinge holder **60** can be tightened axially as much as desired, without inhibiting rotation of the moving piece **14**.

[**0044**] The device **60** also includes a second surface **72** on another spring finger **73** that places lateral or radial pressure on the moving piece **14**, to stabilize the moving piece **14** during operation by eliminating excessive chatter in the hinge. The surface **72** preferably presses against the moving piece **14**, as shown.

[**0045**] The motor **10** is shown installed in a hair clipper **80** in **FIG. 9**. In addition to the motor **10**, the hair clipper **80** includes a case **82**, a fixed, detachable or adjustable stationary blade **84**, and a moving blade **86** positioned opposite the blade **84** and appropriately secured, as in U.S. Pat. No. 5,068,966, entitled "Blade Assembly For Electric Hair Clippers", incorporated by reference in its entirety. The moving blade **86** is operatively connected to the drive member **44**. A power switch and power source are typically connected to wires **87** of the motor **10**, as well, and a cover (not shown) encloses the case **82**.

[**0046**] The case **82** (**FIG. 10**) is typically molded plastic, and includes a first threaded boss **88** for an installation screw **89**, and a second threaded boss **90** for an installation screw **91**. The boss **90** has an inner rim **92** and an outer rim **93**, the rims **92**, **93** being separated by a space **94**. The outer rim **93** is a bearing surface for the moving piece **14**. The outer rim **93** can be lowered to accept a washer, ball bearing, etc., if desired. The screw **91** presses the stationary piece against the rim **92**, without placing pressure on the moving piece. In this manner, motor operation is not affected by the torque placed on the screw **91**.

[**0047**] The motor **10** can be easily pre-assembled and installed in the case **82** as a single unit by placing the assembled motor in the case such that the drive member **44** is operatively connected to the moving blade **86**, and securing the motor with screws **89**, **91**. The screws **89**, **91** are secured in threaded openings in the case **82**. While the motor **10** may be tuned before installation in the case **82**, if desired, it can also be tuned after installation.

[**0048**] The hair clipper **80** can be easily manufactured by securing the stationery blade **84** to the case, usually by screws, and placing the moving blade **86** adjacent the blade **84**, usually using a spring that allows the blade **86** to reciprocate to cut hair. The motor **10** is then installed in the case **80** using screws **89**, **91**, with the drive member **44** engaging the moving blade **86**. A cover is then placed over the case **80** and secured.

[**0049**] While the motor of this invention has been described with respect to a hair clipper, many other applications are contemplated, such as shavers, engravers, electric scissors, air pumps, sprayers, massagers and any other device that can operate with a vibrator motor. In products such as massagers, the moving piece can vibrate openly, without a driver.

[0050] While the principles of the invention have been described above in connection with specific apparatus and applications, it is to be understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What is claimed is:

1. A vibrator motor comprising

a stationary piece; and

a moving piece hingedly secured to the stationary piece, the moving piece being hinged to the stationary piece such that the moving piece itself does not generate mechanical spring forces under the influence of an electromagnetic field.

2. The vibrator motor of claim 1, further comprising

an electrical coil; and

a movement control system connected to the stationary piece and the moving piece, the movement control system having at least one spring and at least one device for adjusting tension in the spring;

whereby the moving piece is moved by electromagnetic fields generated by the electrical coil.

3. The vibrator motor of claim 2 wherein the coil is on the stationary piece, the motor further comprising a driver on the moving piece for connection to a motor load.

4. The vibrator motor of claim 1 comprising a hinge holder having a first surface that retains the moving piece axially while still allowing the moving piece to rotate.

5. The vibrator motor of claim 4 wherein the hinge holder has a second surface that biases the moving piece radially while still allowing the moving piece to rotate.

6. The vibrator motor of claim 1 comprising a hinge holder having a surface that biases the moving piece radially while still allowing the moving piece to rotate.

7. The vibrator motor of claim 2 wherein the driver is crimped to the moving piece.

8. The vibrator motor of claim 1 wherein the stationary piece has a circular shape at a first end of the stationary piece, and the moving piece forms a circular shaped opening at a first end of the moving piece, the circular shaped end of the stationary piece fitting inside of the circular shaped opening of the moving piece.

9. The vibrator motor of claim 8 wherein the movement control system is located at a second end of the moving piece.

10. The vibrator motor of claim 1 wherein the movement control system includes a screw having screw threads and a head, the screw being adjustably threaded in an opening in the stationary piece;

the screw passing freely through an opening in the moving piece, the stationary piece opening being located on one side of the moving piece opening and the screw head being located on the other side of the moving piece opening,

the movement control system further comprising a first spring between the stationary piece and the moving piece, and a second spring between the moving piece and the screw head.

11. The vibrator motor of claim 1 comprising a coil bobbin on the stationary piece around which the coil is wound, the coil bobbin also having an extension to which the movement control system is connected.

12. The vibrator motor of claim 3 wherein the movement control system is connected to the driver of the moving piece.

13. The vibrator motor of claim 1 comprising low friction insert between the stationary and moving pieces where the stationary and moving pieces are hinged.

14. The vibrator motor of claim 1 comprising at least one grease channel where the moving piece is hingedly secured to the stationary piece.

15. A holder for a hinge having an axis, the hinge including a stationary piece and a moving piece hingedly secured to the stationary piece, the holder comprising

a first surface that secures the stationary piece to a case or the like, the first surface not interfering with movement of the moving piece;

a second surface that retains the moving piece axially with respect to the stationary piece; and

a third surface that presses the moving piece radially with respect to the stationary piece.

16. A coil bobbin for a motor having a stationary piece, a moving piece and a movement control system, the bobbin comprising

a winding portion for wrapping wire around the bobbin, the winding portion having an internal opening through which the stationary piece can be inserted; and

an arm extending from the winding portion to which the movement control system can be connected.

17. A hair clipper comprising

a case having at least one attachment point for securing the motor;

a stationary blade on the case;

a moving blade adjacent the stationary blade, the moving blade being adapted for reciprocation across the moving blade; and

a motor secured to the case at the attachment point, the motor including,

a stationary piece having a coil,

a moving piece hingedly secured to the stationary piece, the moving piece being hinged to the stationary piece at one end such that the moving piece itself does not generate mechanical spring forces under the influence of an electromagnetic field,

a driver on the other end of the moving piece, the driver and the moving blade being coupled for movement of the moving blade; and

a movement control system connected to the stationary piece and the moving piece, the movement control system having at least one spring and at least one device for adjusting tension in the spring.

18. The hair clipper of claim 17 comprising a hinge holder having a first surface that retains the moving piece axially while still allowing the moving piece to rotate.

19. The hair clipper of claim 18 wherein the hinge holder has a second surface that biases the moving piece radially while still allowing the moving piece to rotate.

20. The hair clipper of claim 17 comprising a hinge holder having a surface that biases the moving piece radially while still allowing the moving piece to rotate.

21. The hair clipper of claim 17 comprising a coil bobbin on the stationary piece around which the coil is wound, the coil bobbin also having an extension to which the movement control system is connected.

22. A method for manufacturing a hair clipper comprising

molding a case having at least one motor attachment point,

retaining a stationary blade on the case and locating a reciprocating blade adjacent the stationary blade,

assembling a motor having a driver; and

installing the assembled motor in the case and securing it at the attachment point, the driver causing the reciprocating blade to reciprocate when the motor is operated.

* * * * *