Feb. 3, 1970 P. W. NIEMELA 3,493,793

HAIR CLIPPER HAVING OSCILLATING ARMATURE MOTOR

Filed July 5, 1968 2 Sheets-Sheet 1

Fig. 1.

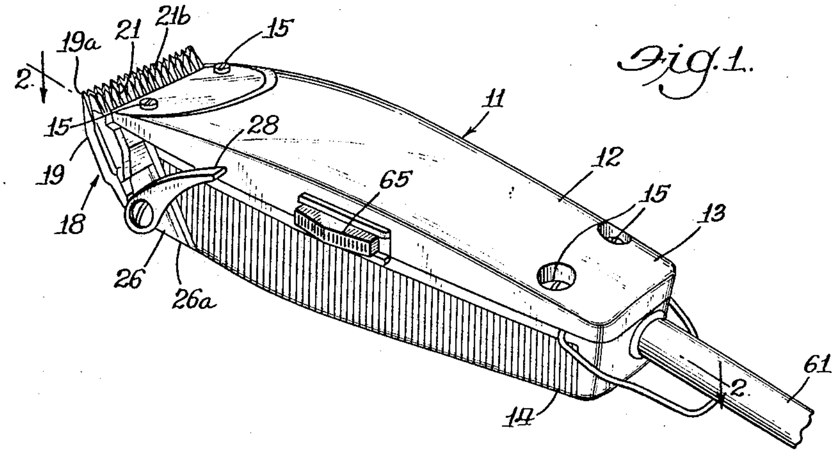


Fig. 4.

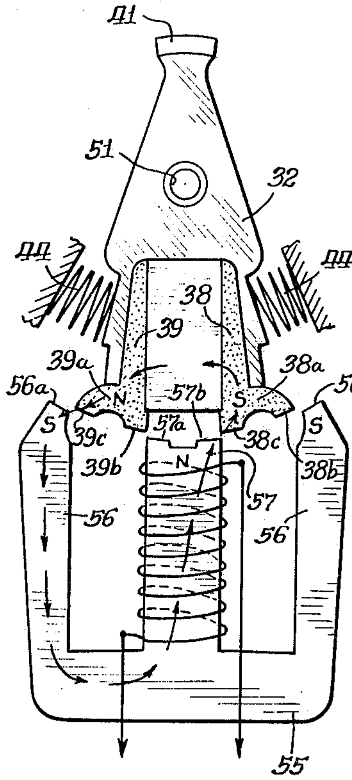


Fig. 5.

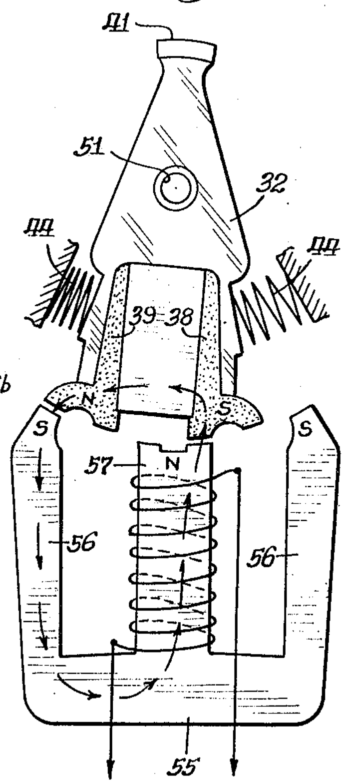
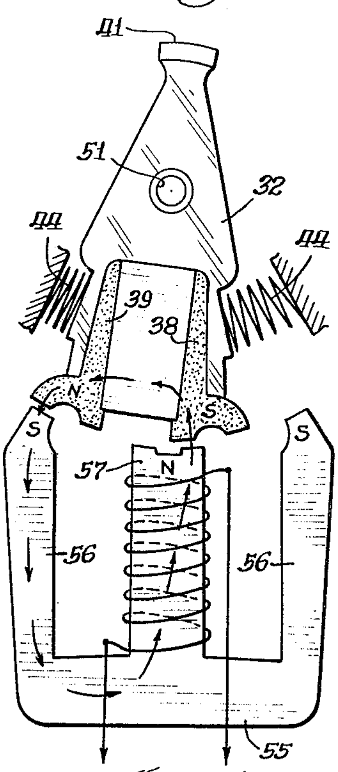


Fig. 6.



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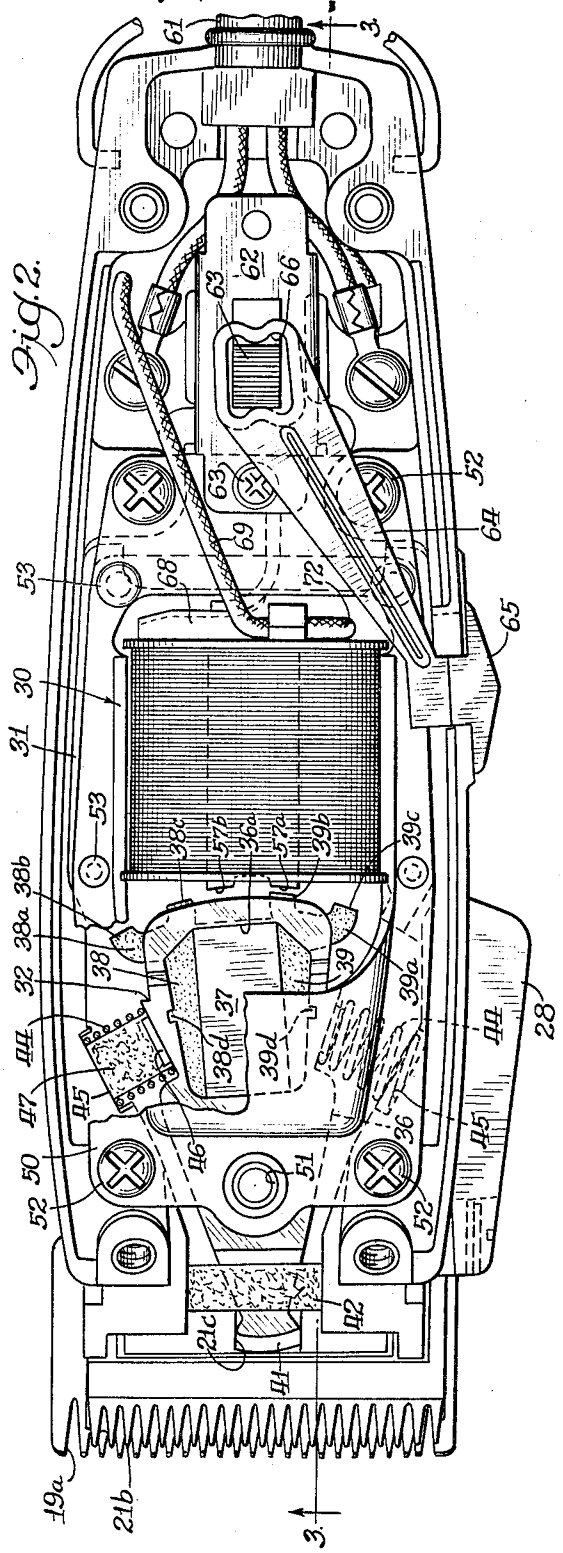

Fig. 2

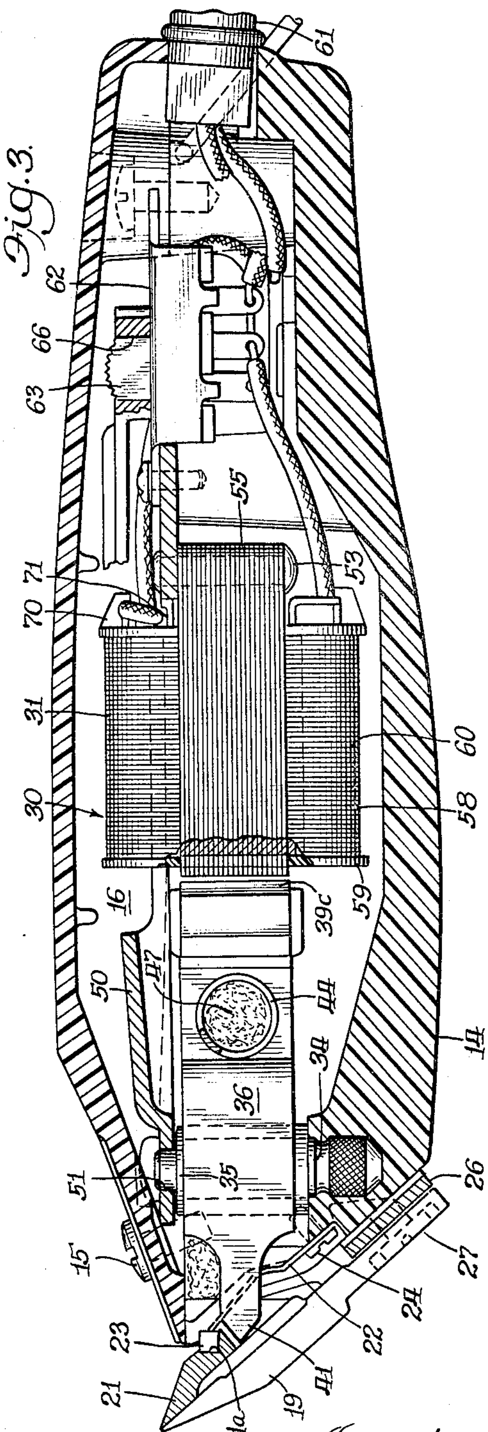

Fig. 3

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HAIR CLIPPER HAVING OSCILLATING ARMATURE MOTOR

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Int. Cl. H02k 33/06
U.S. Cl. 310—29 22 Claims

ABSTRACT OF THE DISCLOSURE

A hair clipper having a vibratory motor mounted in a plastic housing by means of a post which pivotally supports the armature and locates the field supporting frame which is secured to the plastic housing. The armature is provided with a permanent magnet to achieve a frequency of oscillation equal to the frequency of the alternating current source and having two pairs of armature poles cooperating with corresponding field poles to obtain a performance characteristic particularly suited for an electric hair clipper.

BACKGROUND OF THE INVENTION

The invention relates to electric hair clippers and more specifically to an electric hair clipper being driven by an oscillating armature type electric motor. The use of vibratory or oscillating armature type motors has been relatively common in hair clippers for many years. In general, these vibratory motor hair clippers have been lower in cost than the rotary armature motor hair clippers, and as a consequence, their use has been particularly important in the hair clipping sets sold for use in the home. In general, the professional barber is interested in a hair clipper which will be as light as possible and give optimum performance. Accordingly, the barber has been willing to pay the additional cost demanded for the rotary armature motor type of hair clipper.

There have, however, been many attempts to satisfy the barber with a vibrator type hair clipper. The vibrator motors have in general been heavier than the rotary armature motors of similar power. This greater weight is particularly offensive to the barber who must use the hair clipper relatively constantly during the day. Any small additional weight increases his fatigue considerably. Because of this weight problem which is inherent in the vibrator type motor, it is important that the power output per unit weight of such a motor be made as high as possible to permit minimizing the weight for a given power output.

Another problem which has made the vibrator motor hair clipper unpopular is the presence of excessive vibration of the clipper housing. The vibrator motor includes an armature which reciprocates or oscillates to drive the blade of the hair clipper. All mass in the unit which is not a part of the armature vibrates at the same frequency as the armature but in the opposite direction. This vibration is in response to the forces driving the armature and is exhibited as vibration transmitted through the housing to the hand of the user. The magnitude of the vibration, which the clipper housing transmits to the hand, is inversely proportional to the moment of inertia of the field and directly proportional to the moment of inertia of the armature. Accordingly, to produce a hair clipper which

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would utilize an oscillatory motor and be acceptable to professional barbers, it is important to minimize the mass of the armature and to provide a means for reversing its direction of movement with a minimum amount of noticeable housing vibration. While increasing the mass of the field would, of course, reduce housing vibrations, it is also necessary to maintain a light overall weight of the clipper since the barber may use it continuously for long periods.

An additional problem which adds to the unpopularity of the vibratory or magnetic clipper is the sensitivity of the motor to fluctuation in the supply voltage or changes in the load. In order to maintain a fairly constant blade stroke, the conventional vibrator motor powered hair clipper must be adjusted by the user whenever the load changes, such as when a blade set is lubricated or replaced, placed, and whenever the supply voltage fluctuates. Because of the vibrator motor's sensitivity the fluctuating input voltage or changes in the load and the fact that it is important that the motor output remain fairly constant over a range of loads and input voltages thereby eliminating the need for adjustment by the the user, it would be desirable to have a vibrator motor which would not be inherently load sensitive as are the prior art devices.

The conventional construction of the typical hair clipper today involves the use of a split plastic housing which encloses the electric motor. In general, these motors are complete subassemblies which may be merely screwed or bolted to the plastic housing. Since the plastic housing itself must be made of fairly rigid material, it is desirable to utilize the plastic housing as at least a part of the motor supporting frame. In the past, many attempts to accomplish this objective have resulted in complex assembly procedures which have cost more than the savings associated with integrating the motor with the plastic housing.

SUMMARY OF THE INVENTION

The invention is directed to a vibratory electric motor which includes a novel field and armature structure. This structure increases the power output of the motor as compared to prior art motors of the same size, weight, and power input. The armature includes a permanent magnet which is associated with a pair of elongated pole pieces arranged to conduct the magnetic flux produced by the permanent magnet. From each of the pole pieces, a pair of salient pole faces project which cooperate with corresponding salient pole faces on the adjacent field member.

The field is an E-shaped laminated core having an energized coil mounted on the center leg. There is a salient pole formed on the ends of the outer legs and a salient pole having two pole faces formed on the end of the central pole of the field core. With the coil on the center leg energized, the two central field pole faces will always be magnetized at the same polarity and opposite the polarity of the two outer faces at a given point in time. Of the four pole faces on the armature and the four pole faces on the field, all are utilized in each half of the oscillating cycle. Two corresponding pole faces on the field and two on the armature will attract while the remaining two pole faces on the field and the two on the armature repel each other causing the armature to move in one direction. At the current in the coil winding diminishes sinusoidally, the force also decreases. Similarly, as the current changes polarity, the forces on the armature change direction forcing the armature motion to change direction. This arrangement in conjunction with the armature centering springs provides a smooth reversal of armature direction, provides a power stroke in each direction, and limits the motion of the armature to its most efficient range of operation.

Since with the oscillating armature motor it is difficult to maintain a uniform stroke under varying conditions of load and input voltage, the action of the field on the armature at the reversal of direction is particularly important. This action limits the travel of the armature very effectively under light loads or no loads and high voltage conditions and eliminates the need for bumpers or heavy no linear action restraining springs.

The armature is mounted within the plastic housing by means of an armature supporting pin which is molded into the plastic housing which serves as a motor supporting frame. The armature is pivotally supported on this pin and is retained thereon by a metallic frame member which supports the motor field. By having the motor field accurately positioned on the frame member and by having the frame member accurately located through engagement with the end of the armature support pin, one is assured of having the field accurately located with respect to the armature thus permitting a small air gap which is important in obtaining an efficiently operated motor. The field supporting frame is screwed to the plastic housing member which carries the armature support pin but it is located entirely by the armature support pin.

An object of the present invention is to provide a low cost hair clipper which will be light in weight and have a vibratory type motor which will produce little external vibration.

A further object of the present invention is to provide an improved vibrator type motor which is high in efficiency and low in cost.

Another object of the present invention is to provide an improved vibrator type motor having a rate of oscillation equal to the frequency of the alternating current power supply.

Another object of the present invention is to provide by means of the four pairs of armature and field pole faces, a hair clipper having a uniform stroke of oscillation of the armature at various blade loads and with line voltage fluctuations.

Still another object of the present invention is to provide an improved electric hair clipper having an armature support pin molded integrally with one of the plastic housing halves and having this pin serve as a bearing for the armature and a locating means for the motor field.

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.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a hair clipper embodying my invention;

FIG. 2 is an enlarged section view taken substantially along line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2 assuming that FIG. 2 shows the complete hair clipper;

FIG. 4 is a schematic diagram illustrating the relationship between the armature and the field when the armature is in its rest position before energization of the field coil;

FIG. 5 is a schematic diagram similar to FIG. 4 but with the armature shown in its deflected position when the field coil has magnetized the field to move the armature in one direction;

FIG. 6 is a schematic diagram similar to FIGS. 4 and 5 but shows the armature in its extreme position in which it has moved past the position shown in FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown in FIG. 1 a hair clipper designated generally by reference numeral **11.** The hair clipper **11** includes a housing **12** which is made up of two housing members **13** and **14** which are secured together in abutting relation by screws **15** to form a motor enclosure **16.**

Received on the front end of the elongated housing **12** is a blade set **18** which consists of a comb **19** and a cutter **21** which is pressed into shearing engagement with the comb **19** by means of a biasing spring **22.** The biasing spring is a rectangular frame member having a plastic bearing portion **23** secured on its outer end for sliding engagement with a groove **21*a*** formed in the cutter **21.** At its inner edge, the biasing spring **22** is secured to the lower housing member **14** by means of screws **24.**

The comb **19** and the cutter **21** are provided with teeth **19*a*** and **21*b***, respectively, along their abutting outer edges as is best shown in FIGS. 1 and 2. The comb **19** is supported for movement relative to the lower housing member **14** by means of a blade support **26.** The blade support **26** extends across the bottom of the housing member **14** as shown in FIG. 3 and has upwardly and inwardly turned ends **26*a*** which are received in slots in the side wall of housing member **14** permitting the support **26** to slide in the plane of the blade set **18.** The comb **19** is secured to the blade support **26** by means of screws **27.** The position of the blade support and the comb **19** is controlled by means of lever **28** which has on its inner face eccentric means to move the blade support **26** as the lever **28** is rotated. This type of control is old and well known in the art and serves to change the relative position of the comb **19** with respect to the cutter **21** so that the barber may cut hair very short when the blade set is positioned as shown in FIG. 3 or cut hair longer when the comb is displaced further outwardly with respect to the cutter **21.**

Mounted within the enclosure **16** is a motor **30** which includes a field or stator **31** and an oscillating armature **32.** The armature **32** is supported for oscillating movement by means of a bearing pin **34** which is secured to the lower housing member **14** by having its low end molded into the plastic housing member **14.** The armature itself includes an oil impregnated bearing bushing **35** which is secured to a nylon frame or carrier **36.** The carrier **36** is formed with an internal pocket **36*a*** in which is received a permanent magnet **37** and a pair of pole pieces **38** and **39.** The pole pieces **38** and **39** are elongated members of magnetically permeable material such as soft iron and are formed at their outer ends with crescent shaped poles **38*a*** and **39*a*** which define a pair of salient pole faces **38*b*** and **38*c*** and **39*b*** and **39*c*** respectively. Thus, each pole piece has a pair of salient pole faces formed by the crescent shaped poles on the outer ends thereof. The permanent magnet **37** is polarized so that the pole pieces **38** and **39** are magnetized to the opposite polarity. As a consequence, the salient pole faces **38*b*** and **38*c*** formed on the pole **38*a*** will be polarized to the opposite polarity from the other armature pole **39*a*** having salient pole faces **39*b*** and **39*c*.**

In order to assemble the pole pieces **38** and **39** to the nylon carrier **36**, the pole pieces are first inserted through openings **40** until their elongated portions are positioned within the pocket **36*a*.** They are then spread apart until suitable retaining ribs **38*d*** and **39*d*** engage corresponding notches in the nylon carrier **36.** The permanent magnet **37** is then inserted downwardly into the pocket **36*a*** as shown in FIG. 2 thereby locking the pole pieces **38** and **39** against removal or displacement outwardly through the openings **40**. The frictional engagement between the permanent magnet **37** and the pole pieces **38** and **39** within the pocket **36***a* tends to prevent its removal from the pocket **36***a*. In addition, the strong magnetic force of the permanent magnet **37** tends to retain it within the pocket **36***a*.

The nylon carrier **36** of the armature **32** is formed with a driving lever **41** which extends radially from the bearing pin **34** in a direction opposite from the permanent magnet **37** and the pole pieces **38** and **39**. The cutter **21** is formed with a slot **21***c* which receives the end of the driving lever **41**. As the armature **32** oscillates about the axis of the bearing pin **34**, the cutter **21** is reciprocated in shearing engagement with the comb **19**. As is conventional in the hair clipper art, the area around the driving lever **41** where it extends outwardly from the motor enclosure **16** is surounded by a plastic foam **42** which prevents the entrance of hair clippings into the motor **16**.

The armature **32** is biased to a central position by means of coil springs **44** which are compressed between the lower housing member **14** and the nylon carrier **36**. The housing member **14** is formed with a pair of U-shaped recesses or spring seats **45** which receive the outer ends of the springs **44**. The inner ends of the springs **44** are received on locating bosses **46** which are formed integrally with the nylon carrier **36**. To dampen vibration noises which otherwise might be associated with the springs **44**, they are filled with foam plastic material **47**.

The motor field **31** is supported within the motor enclosure **16** by means of a sheet metal member **50** which is the field supporting frame. The member **50** serves not only to support the field **31** but also accurately locates the field **31** with respect to the armature **32**. This accurate location of the field is accomplished by locating the frame **50** from the bearing pin **34**. An opening **51** in the frame **50** receives the upper end of the bearing pin **34** as shown in FIG. 3. The frame **50** is secured to the lower housing member **14** by means of four screws **52** which extend through openings in the corners of the frame **50**. The field **31** is riveted to the frame **50** by means of the rivets **53** which also retain the laminations in assembled relation.

The field **31** includes an E-shaped core **55** made of laminations of magnetically permeable material which are retained together and secured to the frame **50** by means of the rivets **53** as explained above. The E-shaped core **55** has a pair of outer legs **56** and a central leg **57**. The central leg being substantially thicker than the outer legs and terminating in a pair of salient pole faces **57***a* and **57***b*. The outer legs of the core **55** terminate in salient poles **56***a* and **56***b*. Surrounding the central leg **57** of the core **55** is a coil **58** which includes a plastic bobbin **59** and conventional insulated windings **60**. When the coil **58** is energized by current flowing in either direction, it will induce magnetic flux which will cause the salient pole faces on the center leg **57** to be magnetized to one polarity while the salient poles **56***a* and **56***b* on the outer legs will be magnetized to the opposite polarity. It is evident from a review of the schematic diagrams in FIGS. 4–6 that the field will have two pairs of oppositely polarized pole faces. These pairs will be **56***a* and **57***a* and **57***b* and **56***b*. The manner in which these poles cooperate with corresponding armature poles will be explained more fully below.

The hair clipper **11** is provided with a power cord **61** which is connected to the end of the hair clipper opposite from the end on which the blade set **18** is mounted. To control the supply of power to the motor **30**, there is provided an on/off switch **62**. The switch **62** is secured to one end of the field supporting frame **50** by means of a screw **63**. Suitable leads are provided to interconnect the power cord **61**, the switch **62**, and the field coil **58**. It should be noted that the assembly of the parts to the housing **12** is simplified considerably by having the switch **62** mounted integrally with the coil **31** and the supporting frame **50**. The switch **62** is a slide switch having an operating button **63** which, of course, is located within the enclosure **16**.

To permit operation of the switch **62** when the housing members **13** and **14** are assembled together, a switch control member **64** is provided. The switch control member **64** is formed with an outer operating portion **65** which is exposed for finger operation on the outer surfaces of the housing **12**. At the other end of the switch control member, an opening **66** is formed which receives the operating button **63** of the on/off switch **62**. The control member **64** is clamped between the housing members **13** and **14** with sufficient clearance provided for it to slide between its various operating positions. In so doing, the on/off switch **62** may be readily controlled. Thus, the control member **64** provides a simple and effective means of operating the switch **62** through the use of a single plastic part which is merely assembled between the housing members **13** and **14**. The bobbin **59** of the coil **58** is formed with a simplified means for making the lead connections to the very fine coil wire **60**. This means includes a plastic pocket **68** which is formed integrally with the end wall of the bobbin and receives the ends of the coil wire **60** and a connecting lead **69**. An overhanging abutment **70** formed integrally with the ends wall of the bobbin and a lower wall **71** provides a space within which the lead wire **67** may be doubled back forming a loop **72**. As the loop **72** is drawn up into more or less jamming engagement with the overhanging abutment **70** and the wall **71**, a suitable strain relief is provided which prevents the application of any force on the connection between the lead wire **69** and the coil wire **60**.

In analyzing the operation of the hair clipper **11**, it should be understood that the device is intended to be energized by an alternating current power source such as the conventional 60 cycle 110 volt power supply. The coil **58** receives current flowing first in one direction and then in the other direction in each half cycle. This causes the polarity of the field poles to be reversed each half cycle. To understand the operation of the motor **30** and the manner in which the armature interacts with the field attention should be directed to the schematic diagrams of FIGS. 4, 5, and 6. It should be appreciated that the armature poles will, of course, always remain polarized in the same manner which has arbitrarily been shown in the figures as the pole piece **38** polarized south and the pole piece **39** polarized north. When the coil **58** receives current such that the central leg **57** is polarized north, the armature **32** tends to rotate clockwise as shown in FIGS. 4–6 by virtue of the attraction between the salient pole faces **39***c* and **56***a* and pole faces **38***c* and **57***b* and the repulsion between the salient pole faces **39***b* and **57***a* and pole faces **38***b* and **56***b*. The repelling an attracting forces would contribute equally to the output torque when averaged over each entire cycle. The armature **32** moves from the position shown in FIG. 4 to the position shown in FIG. 5 with the above described pole faces which were attracting each other ultimately becoming aligned as shown in FIG. 5. In FIG. 6, it is shown that there is some tendency from the armature **32** to override because of its inertia moving past the field poles. At this point, the attraction exerted by the poles retards the armature movement before the current flow changes and reverses the polarity. This action combined with the action of the springs **44** tends to provide a smooth reversal in the direction of the motion of the armature **32** with a minimum amount of vibration being produced.

The principal difficulties with prior art magnetic or oscillatory type hair clippers has involved the excessive armature vibrations which occur under conditions of no load or high input voltage. If the motor was adjusted to produce the proper stroke under normal voltage and load conditions, there would be a tendency for the armature to increase the stroke substantially when the load was lessened or removed. This would, of course, create significant problems with respect to changing the blade set and introducing varying loads to the motor.

By designing the instant hair clipper to have a normal stroke under load conditions equal to twice the width of the pole faces, I have obtained a hair clipper which provides essentially uniform stroke under varying conditions of load and voltage. When the load is lessened or eliminated, the armature pole faces tend to swing past the field pole faces to which they are attracted. Because the width of the field poles is equal to the width of the armature poles, an attracting force is exerted in a direction to prevent the armature poles from swinging past the field poles in the condition of light load or over voltage.

Many tests have been conducted under conditions of varying load and even with changes in the armature air gaps to represent normal manufacturing conditions. It was found that variations of up to 100 percent in the load produced less than a 15 percent change in the stroke of the motor. In contrast, tests of conventional prior art clippers indicated variations of over 100 percent in the stroke under the same variations in load conditions. Accordingly, by a relatively simple modification in the configuration of the magnetic circuit, I have provided a practical, inexpensive magnetic hair clipper which is for practical purposes insensitive to load and voltage changes. By having the double pairs of pole faces on the armature and the field, I have been able to obtain controlled movement of the armature and thus concentrate the power in the desired range of operation. This vibrator motor is of reasonable physical configuration and has ideal performance characteristics for use in a hair clipper.

While it has been noted above that the armature pole faces are constructed of the same width as the field pole faces, the size and spacing of the magnetic poles should also be considered. The displacement or stroke for which the hair clipper is designed when operating under load may best be illustrated by considering FIG. 5 of the drawings. The motor operates most efficiently when the load is such that the armature displaces to the position shown in FIG. 5 and then oscillates to the corresponding position in the other position. In accomplishing such a rotation, the armature moves through a stroke equal to approximately twice the width of each pole face. Another important design criteria is the dimensioning of each armature pole **38***a* and **39***a* with a width equal to approximately the distance between the outer pole face **56***a* or **56***b* and the adjacent center pole face **57***a* and **57***b*, respectively. This arrangement permits all of the field poles to exert maximum torque in either attracting or repelling the adjacent armature poles.

In this regard, by considering FIG. 4, one may see that armature pole faces are all adjacent to respective field pole faces but are not in overlapping relationship as when a pole face is positioned radially of another pole face. As the magnetic flux causes the armature to rotate from the position shown in FIG. 4 toward the position shown in FIG. 5, substantial torque is developed at the pole faces **39***c* and **38***c* as a consequence of the rapid rate of change of flux in the magnetic circuit. At the same time, there is a force produced at the pole faces **38***b* and **39***b* by virtue of the repelling force exerted by the field pole faces **56***b* and **57***a*. Since the torque reverses in direction as the armature moves toward the position shown in FIG. 6, the clipper is designed so that under full load the stroke will terminate with an outer armature pole face aligned with an outer field pole face. The action illustrated by FIG. 6 is operative only under conditions of light load or high impact voltage when the above described restraining action is necessary.

While there has been illustrated and described a particular embodiment of the present invention, it will be understood that changes and modifications may occur to those skilled in the art, and it is, therefore, contemplated by the appended claims to cover all such changes and modifications as 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. A magnetic motor of the type having an oscillating armature comprising a field including an E-shaped laminated core and coil means for magnetizing the outer legs of said core to the opposite polarity from the center leg, an armature supported by a frame for pivotal movement about an axis spaced from said field, said legs being formed with pole faces having cylindrical curvatures the axis of which is coincident with said armature axis, said armature including a permanent magnet and a pair of pole pieces connected to be magnetized to opposite polarities, each pole piece being formed with a pair of outwardly extending pole faces, said armature pole faces being of the same width as said field pole faces and positioned to move in closely spaced relation to said field pole faces, said armature and field pole faces being spaced so that one pole face of each pair of armature pole faces is attracted to a respective field pole face during each half cycle of alternating current energization of said field coil.

2. The combination of claim **1** wherein the center leg of said E-shaped core is formed with two pole faces, one of which is positioned to cooperate with one of said pole pieces and the other of which cooperates with the other pole piece.

3. The combination of claim **1** where in the rest position of the armature said outer field pole faces are displaced from but immediately adjacent to the outermost edges of said pole pieces so that energization of said coil by an alternating current causes said armature to oscillate through an angle in which the armature pole faces travel a distance equal to twice the width of a pole face.

4. The combination of claim **3** including springs which bias said armature to said rest position, said springs and the attraction between said armature and field pole faces preventing overtravel of said armature under conditions of light load and high imput power.

5. The combination of claim **1** wherein said armature pole faces in each pair are spaced apart a distance equal to the distance between an outer leg field pole face and its adjacent center leg field pole face less the combined width of the armature field poles of one pair.

6. An electric vibratory motor comprising an oscillating armature having two pairs of adjacent salient pole faces, a field having two pairs of salient pole faces, means for inducing magnetic flux in said armature whereby both pole faces in each said pair of armature pole faces will have the same polarity and one pair of armature pole faces will have the opposite polarity from the other pair, a field coil inducing magnetic flux in said field whereby each pole face in each said pair of field pole faces will have the opposite polarity from the other face in that pair, a pole face in each of said pairs of field pole faces being closely spaced to each other and being magnetized with the same polarity, said armature oscillating between two positions in which a pole face of each pair of armature pole faces is aligned with a pole face in each pair of field poles with a completely different set of pole faces being aligned in each of said two positions, said oscillating being produced by energizing said field coil with alternating current.

7. The vibratory motor of claim **6** wherein said armature includes a permenent magnet positioned to magnetize said pairs of armature pole faces to opposite polarities whereby said armature oscillates at the same frequency as the energizing current in the field coil.

8. The vibratory motor of claim **6** wherein said armature includes a pair of radially extending pole pieces formed with said armature pole faces, a permanent magnet positioned between said pole pieces to magnetize them to opposite polarities, each said pair of armature pole faces being formed by crescent shaped members at the ends of said pole pieces.

9. The vibratory motor of claim **6** wherein said field comprises an E-shaped core of magnetically permeable material with said coil on the center leg thereof, said field pole faces which are closely spaced and magnetized to the same polarity are formed on the end of the center leg of said E-shaped field core.

10. The vibratory motor of claim **9** wherein said armature is formed with a pair of elongated pole pieces of magnetically permeable material, said pole pieces extendiing generally radially with respect to the axis of oscillation of said armature, a permanent magnet positioned between said pole pieces to magnetize said pole pieces to opposite polarities each of said pole pieces being formed at its outer end with one of said pairs of salient pole faces.

11. An electric vibratory motor comprising a pivotally mounted armature including a permanent magnet supported by a non-magnetic carrier, said armature having two pairs of salient pole faces each peripherally spaced and all situated equidistant from the axis of rotation of said armature, an E-shaped laminated field core of magnetically permeable material having a field coil wound on the central leg thereof, salient field pole faces formed on the free ends of the outer legs of said field, a pair of salient field pole faces formed on the free end of said central leg, said field pole faces being spaced equidistant from said axis of rotation to provide a uniform air gap between said armature and field pole faces as the armature pivots about its axis, said pole faces being peripherally spaced so that the outermost pole face of one of said pair of armature pole faces is aligned with one of the outer field pole faces when the innermost pole face of the other pair of armature pole faces is aligned with the one of said pair of field pole faces on the central leg which is most remote from said one pair of armature pole faces, said pairs of armature pole faces being symmetrical so that the outermost pole face of the other pair of armature pole faces are aligned with the other of said outer field pole faces when the innermost pole face of said one pair of armature pole faces is aligned with the other of said pair of field pole faces on the central leg.

12. The combination of claim **11** wherein said carrier is formed with a side opening recess in which said magnet is received, a pair of pole pieces spaced apart and in engagement with opposite faces of said magnet so each pole piece is magnetized to the opposite polarity, one of said pairs of armature salient pole faces formed on each of said pole pieces.

13. The combination of claim **12** wherein each said pole piece comprises an elongated portion positioned in said recess in engagement with said magnet and a semicylindrical portion having the curved side thereof connected to said elongated portion and the outwardly extending walls of said semicylindrical portion defining one of said pairs of armature salient pole faces.

14. A vibratory motor comprising a stator having an energizing winding, an armature mounted for oscillatory motion in the magnetic field of said stator and including a molded plastic carrier having an integrally formed drive arm at one end and a magnet supporting portion at the other end bearing means intermediate said drive arm and said magnet supporting portion, an enlarged recess in said magnet supporting portion, a pair of pole pieces insertable into said recess with pole faces extending radially from the end of said magnet supporting portion, a permanent magnet supported in said recess and positioned to magnetize said pole pieces to opposite polarities, and an additional opening into said recess through which said magnet is assembled, said magnet securing said pole pieces in assembled relation to said carrier.

15. The combination of claim **14** wherein said recess is wedge shaped, said pole pieces being positioned in part in passageways extending from said recess to the exterior of said carrier at the outer end of said magnet supporting portion.

16. The combination of claim **15** wherein said portions of said pole pieces within said recess are wedge shaped, said magnet having parallel outer walls which engage said pole pieces, interlocking means on said pole pieces and the walls of said carrier recess to secure said pole pieces against lengthwise displacement out of said recess.

17. The combination of claim **14** wherein said carrier includes passageways extending outwardly from said recess at the outer end of said magnet supporting portion, said pole pieces being positioned in said passageways with said pole faces exposed outside of said carrier and portions of said pole pieces positioned in said recess in engagement with said permanent magnet.

18. The combination of claim **17** wherein said magnet supporting portion of said carrier has a sidewardly facing opening adjacent said permanent magnet and through which said magnet is insertable into said recess, said recess being dimensioned to tightly receive said pole pieces and magnet whereby the parts are retained in assembled relation by virtue of their interfering engagement.

19. The vibratory motor of claim **14** wherein said stator includes an E-shaped laminated core having outer and inner salient pole faces, said pole pieces each being formed with two spaced salient pole faces, said salient pole faces on said core and said pole pieces being of equal width, said energizing winding magnetizing said outer salient pole faces to the opposite polarity from said inner salient pole face, said stator attracting one armature salient pole face of each pole piece during each half cycle of alternating current energization and said stator attracting the other armature salient pole face of each pole piece during alternate half cycles of current energization.

20. An oscillating armature type of magnetic motor comprising a stator having a plurality of salient pole faces, an energizing coil for magnetizing said pole faces to different polarities, said polarities being reversed as said coil is energized by alternating current, an armature having a plurality of salient pole faces and being positioned relative to said stator to be rotated in opposite directions during each half cycle of current, said armature including a carrier of non-magnetic material having pivot means at one end for supporting said carrier for pivotal movement in a plane, a magnet supporting portion on said carrier having a side opening recess with said opening facing said plane of movement, end openings in said carrier communicative with said recess, L-shaped pole pieces having elongated portions within said recess and a pair of salient pole faces on the outer end of each pole piece positioned outside of said recess, said pole pieces extending through said end openings, a permanent magnet received in said recess in engagement with said pole pieces, said magnet being dimensioned to be insertable through said side opening and said elongated portions of said pole pieces being dimensioned to be insertable into said recess through said end openings, said magnet and pole pieces fitting tightly into said recess to retain them therein when said armature is oscillated about said pivot means.

21. The combination of claim **20** wherein said pole pieces and the inside walls of said recess are formed with interengaging ribs and grooves which lock the elongated portions of said pole pieces against lengthwise movement in said recess.

22. The combination of claim **21** wherein said ribs and grooves are positioned so that said pole pieces may be pivoted about said pole faces after insertion of said elongated portions into said recess to engage said ribs and said grooves, said magnet being positioned to retain said pole pieces against pivotal movement.

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