

Dec. 29, 1970

B. PALM

3,550,280

HAIR CLIPPER

Filed July 18, 1966

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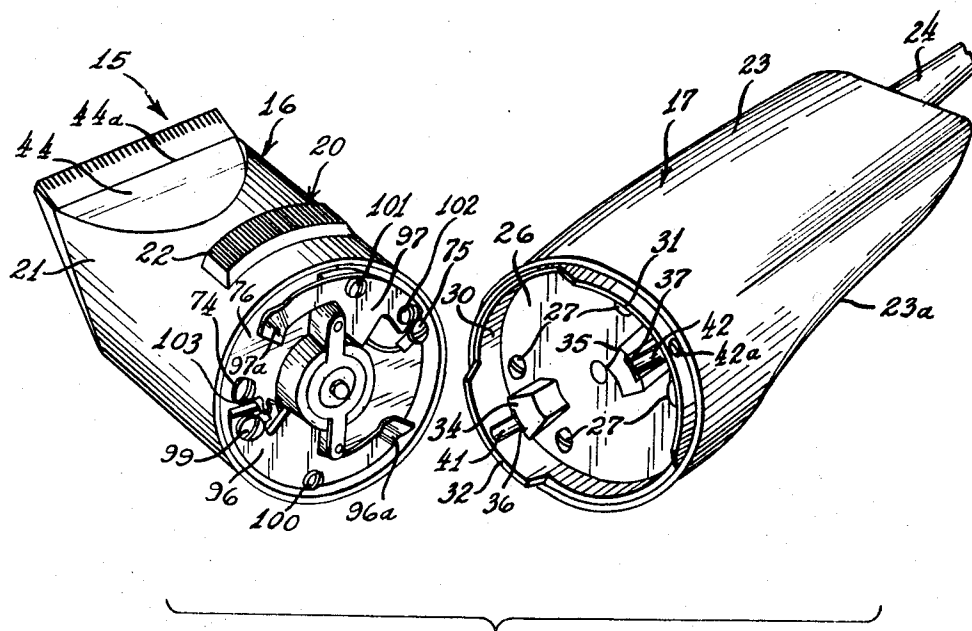
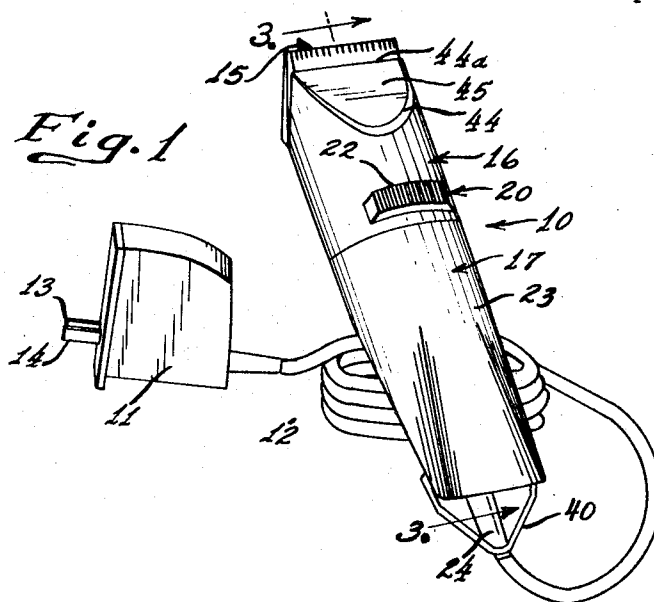


Fig. 2

Inventor
Bernhard Palm
By George R. Clark atty

Dec. 29, 1970

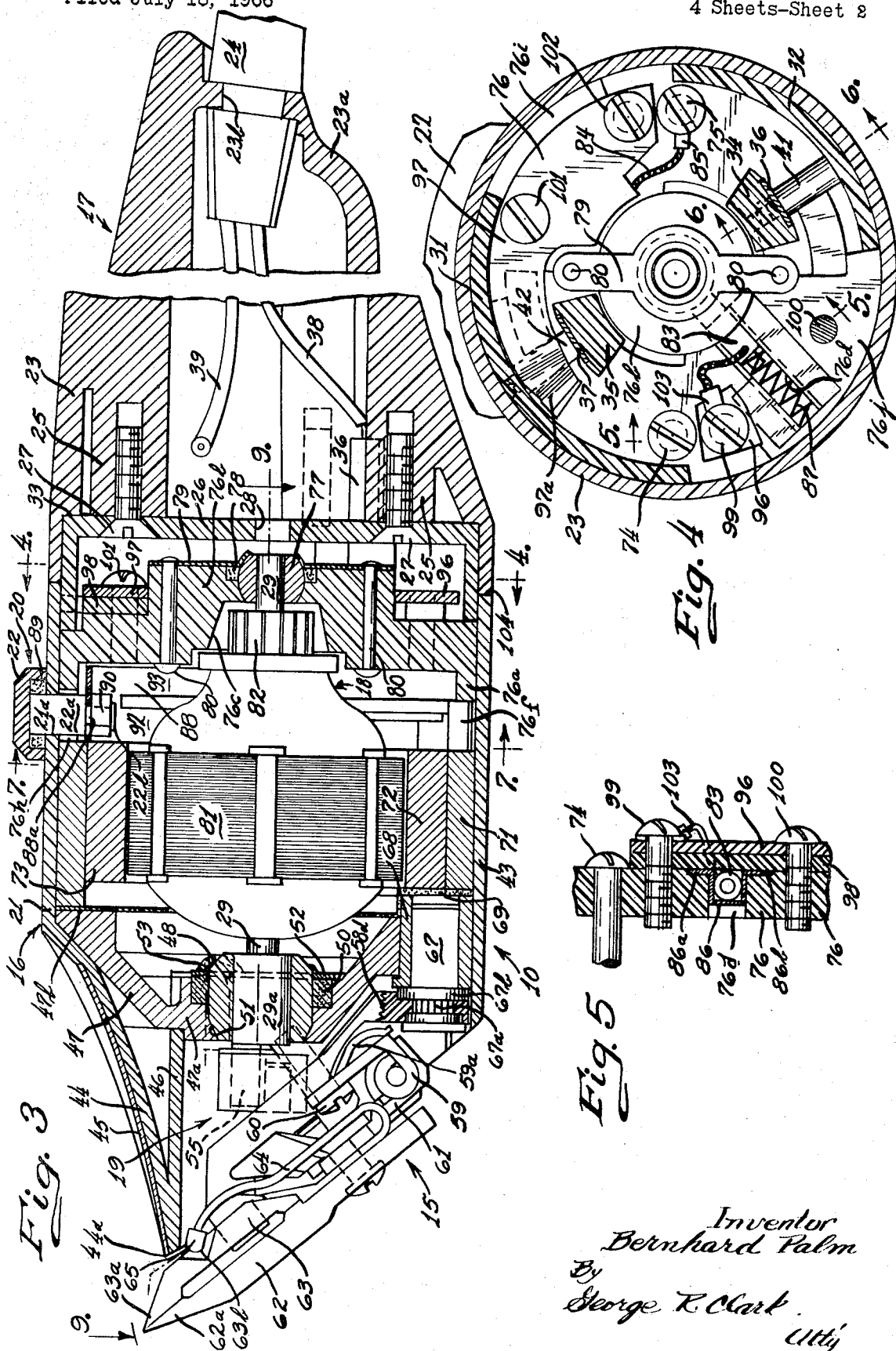
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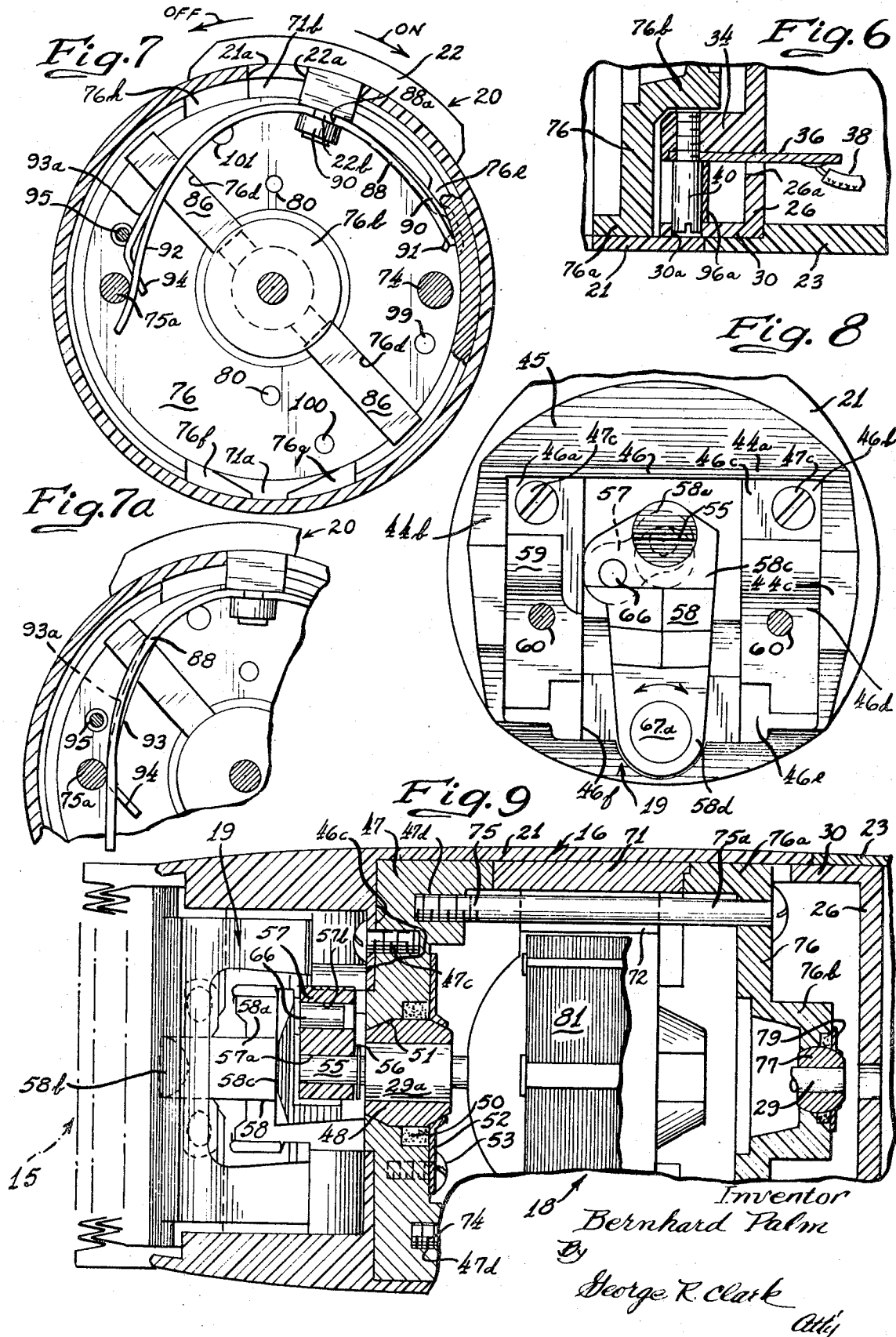
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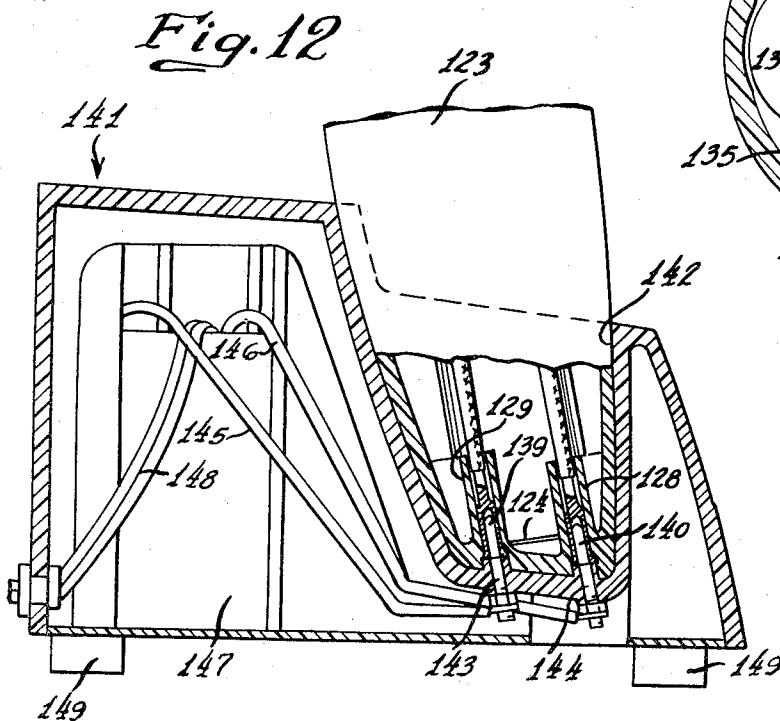
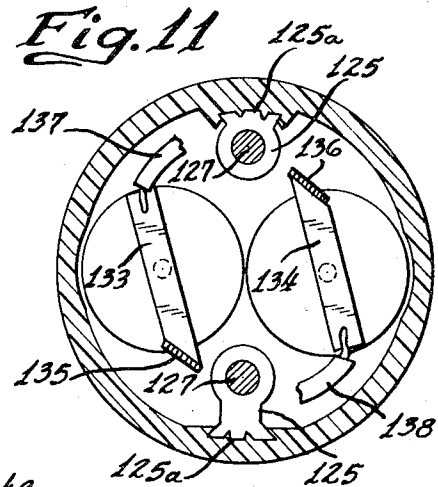
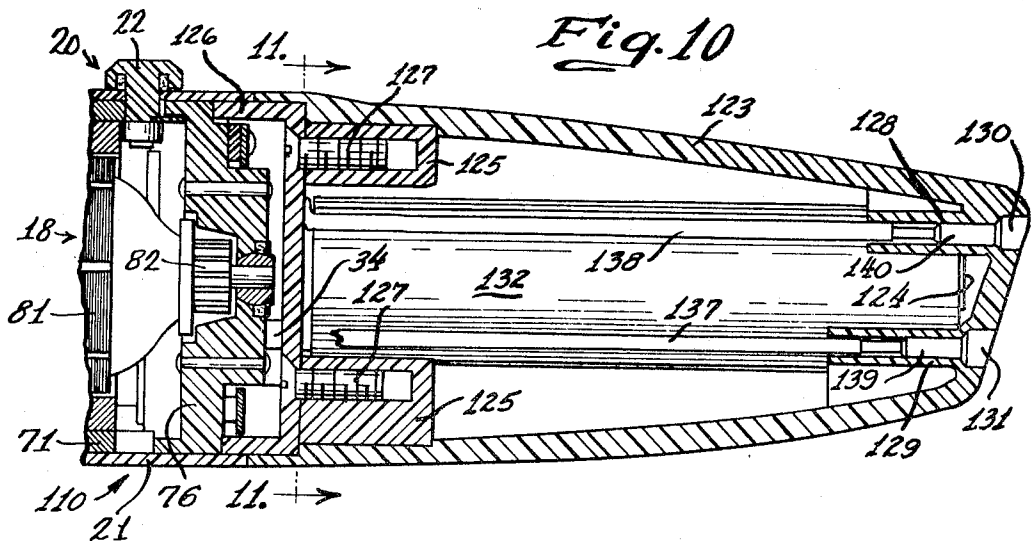
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4 Sheets-Sheet 4



Inventor:
Bernhard Palm
By
George R. Clark, Atty.

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HAIR CLIPPER

Bernhard Palm, Milwaukee, Wis., assignor to John Oster Manufacturing Co., Milwaukee, Wis., a corporation of Wisconsin

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U.S. Cl. 30—217

23 Claims

ABSTRACT OF THE DISCLOSURE

An electric hair clipper having a two part housing, a first of which contains a motor for driving a cutter and the second of which is connected to the first by an interlock arrangement for holding the two housing parts together and for supplying electrical current to the motor. A dust tight switch is mounted upon the first housing part to control the operation of the motor. A drive mechanism employing very few moving parts connects the motor output shaft to the cutter.

This invention relates generally to electric hair clippers and, more particularly, to electric hair clippers for home or professional use in cutting human hair.

It is desirable that electric clippers for use in the home or in a barber shop be sufficiently small, lightweight and compact so that the clippers may be conveniently handled for an extended period of time during normal use. In order to avoid discomfort to the operator holding the hair clipper it is necessary to provide some means for dissipating heat produced by the motor or other moving parts or, in the alternative, to so construct the hair clipper that very little heat is developed. It is also desirable that the motor and additional components of the clipper be enclosed within a housing constructed to prevent the entry of hair or other foreign objects which would interfere with the hair clipper operation. When the housing is so constructed and particularly when the parts are compactly arranged the problem of heat dissipation becomes acute.

The switch for starting the electric motor should be conveniently located so that it can be operated with one hand or one finger as the hair clipper is held. In addition, the housing for the clipper should be so constructed to lend itself to ready disassembly for cleaning or repair but the parts to be disassembled should be so indexed that it is impossible either to assemble them improperly or to disturb the electrical circuit leading to the motor. It is, therefore, a primary object of the present invention to provide a new and improved electric hair clipper which satisfies all of the requirements enumerated above and which is, at the same time, very quiet and efficient in operation over a very long operating life.

Another object of the invention is to provide a new and improved drive connection between a rotating shaft of the electric motor and the cutting mechanism of the hair clipper, which drive connection is characterized by simplicity of construction but is at the same time capable of effectively translating the rotation of the motor shaft into reciprocating movement of a cutter.

A further object of the invention is to provide a new and improved switch construction for use in electric hair clippers, which construction uses a single moveable blade functioning both to lock the switch in at least one of its positions and to control the making and breaking of the electric circuit to the motor.

Additional objects and advantages of the invention reside in certain important construction features which give rise to a very compact arrangement, particularly with respect to the axial length of the hair clipper; economy of parts by employing a single part to perform several func-

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tions; elimination of a number of expensive and space consuming components employed in prior art hair clippers; and the use of a minimum number of moving parts in order to reduce the power requirements and the heat produced. Among the latter construction features particularly worthy of mention are the use of a motor operated at low speed by low voltage DC power so that the motor does not require cooling by a fan or the like as used in prior art hair clippers, which fan is not only space consuming and expensive but also results in generation of noise resulting from rotation of the fan blades and from movement of air at relatively high speed through various areas of the hair clipper. In addition, a direct eccentric drive mechanism between the motor shaft and the cutter uses only two moving pieces, thereby avoiding the necessity for expensive and space consuming reduction gearing or the like. This simplified drive mechanism also extends the operating life of the hair clipper and reduces maintenance and repair problems. Another important construction feature resides in the provision of a switch mechanism operable from the exterior of the housing but nevertheless constructed prevent entry of dust or hair to the interior of the housing. The electric switch terminals are formed by parts of the hair clipper which are used in assembling the different clipper components to avoid the necessity for additional switch terminals and at the same time improving the efficiency of the switch operation. Different parts of the housing may be readily disassembled but are normally held together by locking members which serve both as switch contacts and as locking spring arms cooperating with pin type electrical terminals to provide substantial mechanical force for locking the housing members together and, at the same time, insuring a wide electrical contact area to minimize contact resistance. The housing parts are so constructed that they cannot be assembled improperly and, in addition, these parts are arranged and oriented to insure against accidental shorting of the electric circuits by metal parts when the detachable housing parts are coupled or decoupled, an operation which can be accomplished manually without the use of tools. The coupling and uncoupling members fit within the housing so that they do not increase the overall length of the hair clipper.

The foregoing and other objects are realized in accordance with the present invention by providing an electric hair clipper which includes a pair of separable housing units detachably joined together to provide a compact hair clipper having a smooth external surface without any outwardly projecting parts such as screws or the like to make the hair clipper uncomfortable to hold. A permanent magnet type, DC motor including a commutator and associated brushes is enclosed within a first of the housing units which also supports the hair cutting mechanism at its forward end. The motor shaft extends axially of the first housing unit and has a crank including an eccentric at its forward end cooperating with a two piece driving mechanism to reciprocate a cutter moveable adjacent a fixed comb in the cutting mechanism. A novel switch mechanism is carried by the first housing unit to control the operation of the electric motor. In one form of the invention power is supplied to the hair clipper via an electric cord connected to a remote power pack assembly which is adapted to be plugged into a conventional power outlet. The power pack assembly contains a transformer and suitable rectifiers for converting the AC input into low voltage DC current which is transmitted through the electric cord and through the second housing unit to the switch and motor in the first housing of the hair clipper. Each of the housing units has a cover inserted within one end thereof and the two covers respectively include parts for locking the two units

together when one unit is manually turned with respect to the other during assembly. Indexing members are respectively formed on the two covers to permit the two housing units to be joined together in only one position and, hence, to insure that the DC power supplied to the motor is of proper polarity.

In another embodiment of the invention, customarily known as a cordless unit, the second housing unit contains a battery pack supplying DC current for operating the motor. The hair clipper is stored within a battery recharging unit when it is not in use in order to recharge the batteries in the usual manner.

The invention, both as to its organization and manner of operation together with other objects and advantages, will best be understood by reference to the following detailed description of two illustrative embodiments thereof taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a perspective view illustrating a hair clipper characterized by the features of the present invention and including a remote power pack for supplying DC power via an electric cord to the clipper;

FIG. 2 is an enlarged, perspective view of the two housing units making up the hair clipper shown in FIG. 1 with the units disassembled to illustrate the mechanism for locking them together;

FIG. 3 is an enlarged, longitudinal sectional view taken along a line substantially corresponding to the line 3—3 in FIG. 1 with portions of the second housing unit being broken to conserve space on the drawing;

FIG. 4 is a transverse, sectional view taken along a line substantially corresponding to the line 4—4 in FIG. 3 assuming, of course, that the latter shows the entire clipper construction;

FIG. 5 is a fragmentary, sectional view taken along a line substantially corresponding to the line 5—5 in FIG. 4 and shows particularly the construction of one of the commutator brushes and the associated components for holding the brush in position;

FIG. 6 is an enlarged, fragmentary sectional view taken along a line substantially corresponding to the line 6—6 in FIG. 4 assuming, of course, that the latter shows the entire construction and this figure particularly illustrates one of the electrical terminals of the rear housing unit and the locking mechanism for holding the two housing units together;

FIG. 7 is a sectional view taken along a line substantially corresponding to a line 7—7 in FIG. 3 assuming, of course, that the latter shows the entire construction and this figure illustrates the switch for controlling the operation of the electric motor with the switch means being shown in its on position;

FIG. 7A is a fragmentary sectional view similar to FIG. 7 but shows the switch in the off position;

FIG. 8 is a fragmentary view of the left end of the hair clipper as illustrated in FIG. 3 but with the detachable cutter assembly and its supporting hinge removed from the clipper so that the drive mechanism for the cutter becomes visible;

FIG. 9 is a fragmentary, sectional view taken along a line substantially corresponding to the line 9—9 in FIG. 3 assuming, of course, that the latter shows the entire clipper construction and this figure illustrates particularly the electric motor and the drive mechanism for the cutter;

FIG. 10 is a fragmentary, sectional view illustrating the rear portion of a cordless hair clipper forming a second embodiment of the present invention;

FIG. 11 is a transverse, sectional view taken along a line substantially corresponding to the line 11—11 in FIG. 10 assuming, of course, that the latter shows the entire construction; and

FIG. 12 is a fragmentary, sectional view showing the rear end of the hair clipper illustrated in FIG. 10 resting within the battery recharging unit.

Referring now to the drawings and considering first the embodiment of the invention shown in FIGS. 1 to 9, an electric hair clipper identified generally by the reference numeral 10 is there shown which receives power from a power pack 11 (FIG. 1) via a two conductor electric cord 12. The power pack is provided with male terminals 13 and 14 for insertion into the female terminals of a conventional AC power outlet. The power pack 11 includes a transformer and silicon rectifiers connected as a conventional full wave rectifier to convert the 115 volt AC input to low voltage DC, for example 12 volts, which is transmitted through the two conductor cord 12 to the hair clipper.

As is best shown in FIG. 2, the hair clipper 10 is formed by two detachable housing units 16 and 17 which are adapted to be locked together in a manner described in detail hereinafter. The forward or motor housing unit 16 supports a cutting mechanism indicated generally by the reference numeral 15 in FIGS. 1, 2, 3 and 9 mounted at a suitable angle at the forward end of the unit with the angle being chosen to provide optimum cutting action. An electric motor assembly identified by the reference numeral 18 in FIGS. 3 and 9 enclosed within the housing unit 16 and is connected via a drive mechanism indicated generally by the reference numeral 19 in FIGS. 3, 8 and 9 to drive the cutting mechanism 15. The housing 21 for the unit 16 also supports an electric switch assembly 20 illustrated in FIGS. 3, 7 and 7A for controlling the flow of current to the motor assembly 18. The operating knob 22 for this switch, which knob is illustrated in FIGS. 1, 2, 3, 6, 7 and 7A, is elongated and arcuate in cross section so that it extends around a portion of the periphery of the motor housing 16 and is knurled on its outer face to facilitate manual operation by the finger of the operator.

The housing 23 for the rear unit 17 and the housing 21 are molded or cast from a suitable plastic material having electrical insulating characteristics. Molded constructions of this type may be comparatively light and inexpensive since various ribs, posts, supporting blocks and other supporting and strengthening elements may be molded as integral parts thereof and threaded bushings and the like may be molded therein to permit easy assembly of the different components. As is best shown in FIG. 2 the most rearward portion 23a of the housing 23 is tapered or contoured to provide a streamlined appearance and also to provide a handle section which may easily be held in one hand by the operator. An inlet opening 23b illustrated in FIG. 3 is provided in the rear end of the housing 23 to accommodate a molding 24 of rubber or other insulating material which is affixed to the electric cord 12. The portion of the rear housing around the inlet opening 23b seats within and annular groove in the molding 24 to prevent withdrawal of the cord and, hence, to prevent breaking the electrical terminal connections within the rear housing. To provide means for suspending the hair clipper 10 from a hook or the like when it is not in use, a bale 40 (FIG. 1) is attached to the rear end of the hair clipper by inserting its bifurcated ends into aligned openings respectively formed in opposed sides of the housing 23. Four integrally formed, spaced apart mounting posts 25 are provided internally of the housing 23 for the purpose of supporting a generally circular, rear housing cover 26 which is molded or cast from insulating material like that used for the housings 21 and 23. Each of the posts 25 has a threaded axial opening therein receiving a screw 27 for attaching the cover 26 to the rear housing 23. The four openings in the posts 25 are eccentrically oriented so that they align with the screw receiving openings in the cover 26 in only one position of the cover, thereby preventing improper assembly of the cover on the housing 23. A center opening 28 in the cover 26 is aligned with the armature shaft 29 of the motor to permit limited axial movement of the motor armature. For the purpose of centering the rear housing unit 17 with respect to the

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front unit 16, the cover 26 has a forwardly depending annular flange 30 seating internally within the forward end of the housing 23 but protruding slightly beyond the end of the latter housing and into the rear end of the housing 21. The flange 30 has a pair of peripherally spaced, integral indexing segments 31 and 32 of arcuate shape with the segment 31 spanning a somewhat greater sector than the smaller segment 32 in order to insure assembly of the two housing units 16 and 17 in only one position in a manner described more fully below. The cover 26 seats against the flat forward ends of the four mounting posts 25 and also rests against an annular shoulder 33 (FIG. 3) formed internally of the housing 23 near the forward end. A pair of integrally formed terminal posts 34 and 35 extend forwardly from the cover 26 toward the motor housing 16. The posts 34 and 35 respectively support electrical terminals 36 and 37 each of which extends through an opening 26a (FIG. 6) in the cover 26 and into the interior of the rear housing 23. As is shown in FIG. 3 one of the conductors 38 of the electric cord 12 is connected directly to the terminal 36 while the other cord conductor 39 is connected to the terminal 37. As is best shown in FIG. 6, a contact pin 41 is threaded into a tapped opening formed in the terminal post 34 and extends radially outwardly from the terminal post toward the annular flange 30. The contact pin 41 has a slotted head accessible through an opening 30a formed in the annular flange 30 which may be turned by means of a screw driver when the two housing units 16 and 17 are uncoupled as shown in FIG. 2. As is shown in FIGS. 2 and 4, a similar contact pin 42 extends outwardly from the terminal post 35 so that its head 42a is also accessible when the units are uncoupled. Since the two contact pins extend radially of the axis of the clipper they consume little axial space and, in addition, since they are disposed below the outer extremity of their associated insulating terminal post and also below the outer end of the flange 30 they are to a large extent protected against inadvertent engagement by metal objects on the housing unit 16 or those worn or carried by the operator, thereby to insure against short circuiting of the DC power supply during coupling or uncoupling of the housing units.

Turning next to the construction of the motor housing unit 16 and referring particularly to FIGS. 2, 3 and 9, it will be observed that the housing 21 comprises a rearwardly disposed cylindrical section 43 having a smoothly tapered or flared forward end portion 44 (FIGS. 1, 2 and 3) for accommodating a nameplate 45 which may be affixed to the flared portion 44 by suitable cement or the like. The flared portion 44 terminates in a straight edge 44a lying adjacent to the cutting mechanism 15. The forward end of the housing 21 is recessed and shaped to accommodate the latter cutting assembly and the drive mechanism 19 and, to this end, the housing 21 includes a flat wall 46 (FIGS. 3 and 8) extending rearwardly from the straight edge 44a between a pair of side walls 44b and 44c. The bottom or rear of the latter recess is formed by a pair of spaced apart ledges 46a and 46b (FIG. 8). Each such ledge includes a flat area 46c adjacent the wall 46, an angular, cutter supporting block 46d and a flat region 46e. The two ledges are spaced apart to form a rectangularly shaped opening 46f leading from the recess into the housing 21. To close the opening 46f, the forward end of the housing 21 contains a forward cover member 47 which is seated against the rear end of the wall 46, against the interior of the two ledges 46a and 46b and against the interior of a portion of the flared area 44. The main body of the front cover member 47 is cylindrical in shape and has an outer diameter dimensioned to fit closely within the cylindrical portion 43 of the housing 21. A pair of assembly screws 47c (FIG. 8) extend through appropriate openings in the ledges 46a and 46b and are threaded into tapped openings in the cover member 47 to aid in holding the cover member within the housing 21. The front cover has a central hub 47a with an opening therein

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accommodating a self-aligning front bearing 48 for journalling the forward end of the motor shaft 29. A lubricating wick 50 is mounted within an annular groove formed in the hub 47a around the bearing 48 to provide permanent lubrication for the front bearing assembly so that the unit need not be disassembled by the user for lubrication purposes. The bearing 48 is assembled from the rear and is seated against a tapered or flared ledge 51 (FIG. 3) on the cover 47. A small amount of adhesive sealant is placed on the outer periphery of the bearing prior to insertion and the assembly is completed by a bearing retaining plate 52 which bears against the rear edge of the bearing 48 and is held on the front cover 47 by means of spaced apart screws 53. The bearing journals an enlarged diameter portion 29a of the armature shaft which portion has an eccentric pin 55, best shown in FIGS. 3, 8 and 9, extending forwardly therefrom to form a crank for driving the mechanism 19. The drive mechanism 19 comprises only two pieces, namely, a drive arm 58 and a connecting link 57 in the form of a figure eight shaped member having a first opening 57a therein (FIG. 9) for accommodating the eccentric pin 55 and having a second opening 57b extending parallel to but spaced from the opening 57a. A washer 56 is interposed between the connecting link 57 and the enlarged diameter portion 29a of the armature shaft to facilitate pivotal movement of the connecting link as the eccentric pin 55 is turned by the motor. The drive arm 58 is connected between the link 57 and the cutting mechanism 15 to transfer the pivotal movement of the connecting link to the cutter.

The cutting mechanism 15 is similar to that illustrated and described in detail in U.S. Pat. No. 2,928,171, issued to John Oster and assigned to the same assignee as the present invention and, hence, will not be described in detail. Briefly, this cutting mechanism comprises a cutting head detachably mounted upon a hinge 59 secured to the angular blocks 46d on the two ledges 46a and 46b by means of screws 60 (FIG. 3) each of which extends through aligned openings in the hinge and in the angular block and is threaded into a tapped opening in the front cover member 47. The cutting head is carried by a tongue 61 mounted for pivotal movement on the hinge 59 which tongue may be pivoted about the hinge in a counterclockwise direction as viewed in FIG. 3 so that the cutting head may be removed from the tongue and replaced by another head. A leaf spring 59a coacts with the hinge and the tongue to lock the hinge firmly both in the operating position shown in FIG. 3 and in the pivoted position for exchanging cutting heads. The blocks 46d are inclined at a preselected angle to support the cutting mechanism in proper angular position to perform the desired cutting operation.

The cutting head includes a fixed comb 62 having a plurality of teeth 62a at its outer end cooperating with similar teeth 63a formed on a reciprocating cutter 63 to perform the hair clipping operation in conventional manner. The mating or abutting surfaces of the fixed comb 62 and the reciprocating cutter 63 are highly polished to facilitate the sliding movement therebetween. The cutter is urged against the comb by a leaf spring 64 carrying an elongated finger 65 on its free end riding within a generally V-shaped groove or channel 63b formed in the rear face of the cutter. The elongated finger 65 is formed of a material such as Teflon which will permit sliding movement of the cutter relative to the finger.

Transfer the drive from the connecting link 57 to the cutter 63, the drive arm 58, which is molded from insulating material like that used for the housings 21 and 23, includes a finger 58a having a pointed or V-shaped outer end 58b (FIGS. 8 and 9) extending into a yoke formed in the cutter. The finger 58a projects outwardly from an intermediate body portion 58c carrying an eccentric pin 66 seated within the opening 57b in the connecting link. The body portion has a ledge 58d at its rearward end

carrying a pivot pin 67 which is secured to the ledge by means of a head having a knurled shank portion 67a and an enlarged diameter collar 67b. The collar seats against the outer end of a sleeve bushing 68 mounted within an opening formed near the periphery of the front cover 47. The drive arm 58 is thus supported upon the housing unit 16 for pivotal movement about the pin 67 as the connecting link 57 is turned, the pivotal movement being imparted to the drive arm 58 through the eccentric pin 66. The drive to the cutter is thus effected through a simple, two piece mechanism compactly arranged to avoid increasing the axial length of the hair clipper and devoid of reduction gearing or other expensive components. The connecting link is formed of a suitable insulating material to avoid any metal to metal contacts between moving parts of the drive mechanism with the result that the operation is very quiet. Since the drive arm is slightly flexible and since the parallel openings 57a and 57b in the connecting link 57 permit slight axial movement between the motor shaft and the drive arm, there is little danger of jamming or of excessive wear on any moving parts and, hence, the operating life of all of these parts is extended. Moreover, the power absorbed by the drive mechanism is very low but the latter mechanism is nevertheless highly efficient in transferring power to the cutter.

The motor assembly 18 is of the permanent magnet, DC operated type and is best shown in FIGS. 3 and 9 of the drawings. The motor drives its armature shaft 29 at very low speed in the order of 2,000 revolutions per minute as compared with 20,000 r.p.m. utilized in prior art hair clippers. The low speed, low power operation results in generation of very little heat and, as a consequence, there is no necessity for a cooling fan as employed in prior art hair clippers. Such fans not only require power for operation but also generate considerable noise both from the rotation of fan blades and from the movement of air at high speeds through confined areas of the hair clipper. The hair clipper of the present invention is very quiet and generates very little heat so that the body temperature remains very low even after operation for long periods. The DC operation also permits the motor to attain rated speed rapidly without a warm-up period, thus providing effective cutting action as soon as the switch 20 is closed.

The stator of the motor assembly 18 comprises a cylindrical, magnetic ring 71 formed of low carbon, cold rolled steel and fitting closely within the interior of the cylindrical portion 43 of the housing 21. The forward end of the ring 71 is sealed to the flat, annular, rear face 47b of the front cover by means of a suitable sealant type cement indicated at 69. A pair of permanent magnet pole pieces 72 and 73 formed a barium ferrite and each comprising a segment of a cylinder are inserted into the ring 71 and have their forward end faces sealed to the cover 47. The pole piece segments are spaced apart to provide two gaps through which respectively extend a pair of elongated mounting screws 74 and 75 (FIGS. 7 and 9) for securing a rear cover 76 to the front cover 47. The ends of the screws 74 and 75 are respectively threaded into tapped, rearwardly facing openings 47d (FIG. 9) formed in the front cover 47. In addition, each screw is provided with a smooth shank portion, as indicated at 75a on the screw 75 in FIG. 9, so that the screw 75 may serve both as a switch terminal and as a mounting screw as will be described more fully hereinafter. The rear cover 76 has an annular forwardly extending flange 76a thereon seating against the rear end face of the stator ring 71 and also has a central hub 76b containing a rear bearing 77 for supporting the rear end of the motor shaft 29. An annular groove extending around the inner face of the hub contains a wick 78 for lubricating the rear bearing 77. A bearing retainer plate 79 secured to the rear face of the hub portion 76b by means of rivets 80 is seated against the bearing 77 to hold the bearing in position. The hub 76b is cored or hollowed to form a

recess 76c for accommodating a commutator ring 82 forming part of the motor assembly 18.

The armature 81, which is formed by a single lap winding, fits within the pole pieces 72 and 73 and the commutator ring 82 is mounted on the shaft 29 between the armature and the rear bearing 77. The periphery of the ring is engaged by a pair of diametrically opposed brushes one of which is designated by the reference numeral 83 in FIG. 4 but the other of which is not visible in this figure although its lead 84 and associated brush terminal 85 can be seen. The terminal 85 is connected directly to the elongated assembly screw 75 referred to above and, to this end, the terminal is held by the head of the screw as is clearly shown in FIG. 4. The two brush assemblies are identical and, as is best shown in FIG. 5, each includes a tube 86 forming an open sided channel for the brush. Each tube channel extends through a slot 76d extending radially of the rear cover 76 and opening to the hub core or recess 76c. Extending outwardly from the brush channel are a pair of flanges 86a and 86b which seat within suitable recesses provided in the rear cover adjacent each of the two radial slots 76d. The brushes are retained within the channel of the tube 86 by certain of the components making up the switch assembly 20 described in detail hereinafter so that the latter components serve both as brush retaining members and as switch supporting members. Each of the brushes is biased into engagement with the periphery of the commutator ring 82 by means of a coil spring 87 which seats within the channel of the brush tube 86 and bears against the outer end of the brush. Since the commutator ring 82 rotates at a very low speed the life of the brushes is much greater than that of prior art hair clippers. The hollow hub 76b overlying the commutator ring decreases the axial length of the hair clipper and permits the rear cover to perform a number of functions in addition to that of closing the housing 21. Thus, the rear cover carries the rear bearing for the motor shaft and also supports both of the commutator brush units. The rear cover 76 also supports a number of components of the switch assembly 20 some of which function as brush retainers and, in addition, the rear cover supports certain of the parts for coupling the housing units 16 and 17 together. Despite the fact that this cover and its associated parts perform so many functions it nevertheless fits within the rear end of the housing 21 and, hence, does not increase the overall length of the hair clipper 10.

Considering next the construction of the switch assembly 20 and referring particularly to FIGS. 3, 4, 7 and 7A this switch comprises, in addition to the knob 22 operable from the exterior of the housing unit 16, a moveable switch member in the form of an elongated, generally arcuate switch blade 88. This blade fits within the annular flange 76a on the rear cover 76 and includes an intermediate body portion having a notch 88a with a rounded bottom to facilitate attachment of the blade to the operating knob 22. As is best shown in FIGS. 1, 2 and 4, the knob is elongated and is arcuately shaped to fit closely against the periphery of the housing 21 with its knurled outer face conveniently accessible for operation by one finger of the operator. A rectangularly shaped washer 89 of felt or other soft material is seated within a correspondingly shaped recess on the underside of the knob 22 and bears against the periphery of the housing 21 to prevent entry of dust or hair through an elongated switch opening 21a formed in the housing. The knob 22 includes a rectangular block 22a formed integrally with the knurled operating portion and extending through the elongated arcuate switch opening 21a. A stake 22b having a flattened head thereon is inserted into the notch 88a to join the switch blade 88 to the operating knob and an annular collar 90 is interposed between the flattened head of the stake 22b and the switch blade to complete the connection. The opposed blind ends of the elongated slot 21a cooperate with the

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rectangular block 22a to limit the movement of the knob as it is moved between the on position shown in FIGS. 7 and the off position shown in FIG. 7A. The switch blade includes a flexible arm 90 with a hooked end 91 thereon cooperating with a teat 76e formed integrally with the flange portion 76a of the rear cover 76 to provide a detent for locking the switch in its on and off positions. The switch blade 88 further includes a pair of parallel, flexible contact arms or bifurcations 92 and 93 with the arm 92 being slightly longer than the arm 93. The end of the flexible arm 92 bears against the smooth shank 75a of the assembly screw 75 to provide firm, self-cleaning, wiping engagement therebetween. The arm 93 has a hooked end 94 extending outwardly from a flattened area 93a of the arm, which flattened end area is adapted to be moved into and out of engagement with a switch terminal contact pin 95 as the knob 22 is moved between the on and off positions. In the on position of the switch 20 illustrated in FIG. 7 the arm 93 engages the contact pin 95 so that the latter pin is connected through the switch blade 88 to the elongated screw 75. In this position of the switch the hook end 91 of the detent arm 90 engages the teat 76e to hold the switch blade and the knob 22 in the on position. When the switch operating knob 22 is moved in a counterclockwise direction as viewed in FIG. 7 to the position shown in FIG. 7A the detent arm rides over the teat 76e so that the hook end 91 bears against the teat to lock the switch in the off position. As the switch blade 88 is moved to the off position shown in FIG. 7A the bent end 94 of the flexible arm 93 engages the shank 75a to flex the arm 93 inwardly until the flattened area 93a no longer engages the contact pin 95, thus breaking the electrical connection between the latter pin and the shank 75a and interrupting the circuit to the electric motor in a manner which will become evident as the description proceeds.

To establish electrical connections between the motor housing unit 16 and the rear housing unit 17 and also to lock these two units together, a pair of spaced apart relatively flat spring contacts 96 and 97, best shown in FIGS. 2, 3, 4 and 6, are mounted on the rear of the cover 76 for detachable engagement with the contact pins 41 and 42 described above. Each of the contacts 96 and 97 is formed of conducting material and each is mounted upon an insulating support 98 which is interposed between the spring contact and the rear cover 76. The spring contact 96 and its associated insulating spacer are secured to the rear face of the cover 76 by means of screws 99 and 100 while the spring contact 97 and its associated insulating block are mounted upon the rear cover by means of screws 101 and 102. The terminal pin 95 referred to above is formed integrally with and projects forwardly from the end of the screw 102 so that the latter screw serves both to support the contact 97 and its insulating spacer 98 and as a terminal or contact for the on-off switch. The screw 99 in addition to its function of aiding in attaching the spring contact 96 to the housing, also serves to connect the terminal 103 of the brush 83 to the spring contact 96.

The spring contacts 96 and 97 are respectively provided with hooked ends 96a and 97a which are adapted to be inserted beneath the transversely extending contact pins 41 and 42, respectively. Thus, with the two housing units 16 and 17 in the disassembled or uncoupled positions shown in FIG. 2 the assembly is accomplished manually and without the use of tools by placing the units together and then twisting one with respect to the other until the hooked ends 96a and 97a pass beneath and firmly engage the contact pins 41 and 42. The two units are centered with respect to each other by entry of the annular flange 30 on the cover 26 into close fitting relationship with the rear end of the housing 21. The spring contacts provide mechanical force for locking the two units 16 and 17 together, this force being applied in opposite radial directions by the hooked ends 96a and 97a. In addition,

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the spring contacts engage the pins 41 and 42, provide wide area, self cleaning electrical contacts of minimum resistance properly polarized to energize the motor assembly 18 to start the hair clipping operation. As was mentioned above, the support insulators 98 for the spring contacts overlie the radial slots 76d and the open sides of the brush tubes 86 so that these insulators also serve as brush retainers. When the two housing units 16 and 17 are assembled with their ends abutting as indicated at 104 in FIG. 3, all of the coupling members are located internally within the housings 21 and 23 and, hence, the coupling mechanism does not increase the axial length of the hair clipper 10. When the assembly is completed there are no screws in any external side surface so that the hair clipper is comfortable to hold and, in addition, there are no openings leading to the interior of the housing unit so that hair and other foreign materials are prevented from entering. The combined units, when coupled together, present a smooth external surface that is very easy to clean.

With the housing units 16 and 17 joined together in the manner just described the electrical circuit to the motor 18 may be completed merely by moving the switch knob 22 to the on position shown in FIG. 7. The latter electrical circuit extends from one input conductor 38 through the terminal 36, through the contact pin 41, through the spring contact 96, through the brush terminal 103, through the brush 83 to the commutator ring 82, through the winding of the armature 81 back through the commutator ring 82 to the other brush, through the lead 84 and the brush terminal 85 to the screw 75, through the wiper arm 92 of the switch blade 88, through the arm 93, through the terminal pin 95 and its integrally formed screw 102, through the spring contact 97, through the contact pin 42 and through the terminal 37 to the other conductor 39. To deenergize the motor when the hair clipper is not in use the switch knob 22 is moved to the off position shown in FIG. 7A to break the circuit between the wiping arm 93 and the terminal pin 95 in the manner described above.

As was previously indicated, the hair clipper 10 of the present invention is provided with a number of components to prevent improper assembly of the various parts. Thus, the rear cover 76 includes a pair of adjacent legs 76f and 76g (FIGS. 3 and 7) protruding forwardly from the flange 76a and received within a shallow recess 71a formed in the rear end of the stator ring 71. The stator ring has a second shallow recess 71b formed therein at a position diametrically opposed to the recess 71a for accommodating an indexing ear 76h formed on the flange of the rear cover 76. The recess 71b is aligned with the elongated switch slot 21a in the housing 21 to accommodate the block 22a of the switch knob. When the rear cover 76 is assembled on the housing 21 the ear 76h fits within the recess 71b adjacent one extremity thereof so that it does not block the opening 21a. It is also possible to assemble the rear cover 76 improperly in a position displaced 180° from that shown in FIG. 7 (because in this position the assembly screws 74 and 75 could be inserted through openings in the cover 76) but if this were done the two legs 76f and 76g would extend into the recess 71b and block the slot 21a so that the switch knob 22 could not be assembled. Thus, the rear cover 76 can be placed on the housing 21 in only one position, thereby to insure proper polarities of the electrical terminals for the commutator 82 and the armature winding 81.

Provision is also made for preventing improper assembly of the two units 16 and 17 when they are coupled together. To this end the rear cover member includes a pair of spaced apart, raised indexing blocks 76i and 76j both formed on the rear face of the cover member as is best shown in FIG. 4. The block 76i is considerably narrower than the block 76j and is so positioned with respect to the latter block and with respect to the indexing members 31 and 32 that the cover members 26 and 76 will fit together in only one position. Thus, the indexing mem-

ber 31 is too large to fit into the space between the blocks 76i and 76j that is occupied by the member 32 of FIG. 4. The indexing members 31 and 32 and the blocks 76i and 76j are positioned and dimensioned to permit limited turning movement between the cover 26 and the rear cover 76 so that the two housing units can be coupled together and interlocked in the manner described previously but the rear cover member 26 can be joined to the cover member 76 in a single position thus assuring that DC power of proper polarity is supplied to the motor assembly 18. When the two housing units 16 and 17 are coupled together by passing the spring contacts 96 and 97 underneath the contact pins 41 and 42, the end faces of the blocks 76i and 76j cooperate with the sides of the terminal posts 34 and 35 to form stops for limiting the turning movement of one housing unit with respect to the other.

A cordless embodiment of a hair clipper 110 characterized by the features of the present invention is illustrated in FIGS. 10, 11 and 12 and is very similar to the embodiment shown in FIGS. 1 to 9. Corresponding parts have been assigned the same reference numerals and, to avoid repetition, these parts will not be described again. The cordless hair clipper 110 differs from the remote power pack embodiment shown in FIGS. 1 to 9 in that it employs a rear housing 123 of somewhat different construction than the housing 23 previously described. The cover 126 for the housing 123 is very similar to the cover 26 described above and is secured to the housing by two spaced apart screws 127, which are respectively threaded into a pair of inserts 125 cemented to the interior of the housing 123. To increase the bond between the inserts 125 and the housing, each of the inserts 125 includes a serrated face 125a mating with similar serrations formed within the housing, thereby to provide a relatively large area of engagement between the two surfaces to be cemented together. The housing 123 further includes at its rear end a pair of terminal forming hollow posts 128 and 129 aligned with openings 130 and 131. A battery pack 132 comprising a group of rechargeable battery cells is mounted within the housing 123 and is retained in position by a pair of battery retaining members 133 and 134 which have forwardly extending terminals 135 and 136 respectively formed thereon. The terminals 135 and 136 extend through openings in the cover 126 and lie adjacent insulating terminal posts like the posts 34 and 35 described above but only one of these posts 34 is visible in FIG. 10. The terminals of the battery pack opposite to the terminals 135 and 136 are electrically joined by a conducting strap 124. A conductor 137 is connected to the battery retainer 133 and extends through the housing to the terminal post 129 where it is electrically connected with a conducting sleeve 139 forming a female socket or terminal. Similarly, the battery retaining member 134 is connected via a conductor 138 to a female socket or terminal 140 mounted within the post 128. When the hair clipper 110 is not in use it is stored with a battery recharging stand identified by the reference numeral 141 in FIG. 12. The stand 141 is formed of insulating material like that used for the housing 123 and includes a well 142 for accommodating the handle or rear portion of the hair clipper 110. A pair of male terminals 143 and 144 are fixedly secured to the bottom of the well and mate with the female sockets 139 and 140 respectively when the hair clipper 110 is placed in the well. The male terminals 143 and 144 are connected by conductors 145 and 146 to a battery recharging unit 147 of conventional construction which has its input connected via a two-conductor electric cord 148 to the usual AC power source. The stand 141 is supported upon insulating feet 149 so that it can be placed on a finished surface or the like without damaging the surface. It will be understood that the recharging unit serves to recharge the battery pack 132 whenever the hair clipper 110 is stored in the well 142. In all other respects the hair

clipper 110 is like the unit 10 shown in FIGS. 1 to 9 and described in detail above.

While particular embodiments of the invention have been illustrated and described it will be recognized that many changes and modifications will readily occur to those skilled in the art and it is, therefore, contemplated by the appended claims to cover all such changes and modifications which fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An electric hair clipper comprising a housing, a motor driven shaft within said housing, a cutting mechanism carried by said housing and including a cutter reciprocally mounted for movement within a plane extending transversely of the axis of said shaft and inclined with respect to a plane normal to said shaft, a drive arm mounted for pivotal movement upon said housing about an axis extending parallel to but displaced from the axis of said shaft, said drive arm including a body portion inclined with respect to said pivot axis and carrying a member engaging said cutter at a position remote from the pivot axis, a crank including an eccentric mounted on said shaft, and a connecting link engaging said crank and connected to said drive arm at a point intermediate said pivot axis and said member to pivot said drive arm about said pivot axis as said crank is turned with said shaft.

2. The apparatus defined by claim 1 wherein said connecting link includes means for engaging said eccentric to permit limited movement of said crank relative to said drive arm in a direction extending axially of the shaft.

3. The apparatus defined by claim 1 wherein said connecting link comprises a member having two spaced openings therein having parallel axes, one of said openings accommodating said eccentric, and a pin carried by said drive arm at said point and extending into the other of said openings.

4. An electric hair clipper comprising a housing, a motor driven shaft within said housing, a cutting mechanism carried by said housing and including a cutter reciprocally mounted for movement within a plane extending transversely of the axis of said shaft, a drive arm mounted for pivotal movement upon said housing about an axis extending parallel to but displaced from the axis of said shaft, said drive arm including a body portion carrying a member engaging said cutter at a position remote from the pivot axis, a crank including an eccentric mounted on said shaft, and a connecting link engaging said crank and connected to said drive arm at a point intermediate said pivot axis and said member to pivot said drive arm about said pivot axis as said crank is turned with said shaft, said connecting link including means for engaging said eccentric to permit limited movement of said crank relative to said drive arm in a direction extending axially of the shaft.

5. An electric hair clipper comprising a housing, a motor driven shaft within said housing, a cutting mechanism carried by said housing and including a cutter reciprocally mounted for movement within a plane extending transversely of the axis of said shaft, a drive arm mounted for pivotal movement upon said housing about an axis extending parallel to but displaced from the axis of said shaft, said drive arm including a body portion carrying a member engaging said cutter at a position remote from the pivot axis, a crank including an eccentric mounted on said shaft, and a connecting link engaging said crank and connected to said drive arm at a point intermediate said pivot axis and said member to pivot said drive arm about said pivot axis as said crank is turned with said shaft, said connecting link comprising a member having two spaced openings therein having parallel axes, one of said openings accommodating said eccentric, and a pin carried by said drive arm at said point and extending into the other of said openings.

6. An electric hair clipper comprising a first housing unit, a cutter mechanism carried by said first unit, an electric motor drivingly connected to said cutter mechanism and mounted within said first unit, a first pair of electrical terminal means on said first unit, means electrically connecting the terminal means of the first pair to said motor, a second housing unit detachably secured to said first unit and including a second pair of electrical terminal means, each terminal means of one of said pairs including a flexible contact and each of the terminal means of the other pair including a fixed contact member, each of said flexible contacts engaging one of said fixed contacts to apply a mechanical force for holding said first and second housing units together and for establishing electrical connections between the two units.

7. The apparatus defined by claim 6 wherein each flexible contact comprises a substantially flat spring arm extending generally normal to the longitudinal axis of the hair clipper and wherein each fixed contact member comprises a pin extending transversely of said axis.

8. The apparatus defined by claim 6 wherein said first and second housing units include indexing means permitting assembly of said units in only one position so that each of the terminal means of the first pair engages a predetermined one of the terminal means of the second pair.

9. An electric hair clipper comprising a housing having front and rear ends, a cutting mechanism mounted on said housing adjacent said front end, a cover detachably secured to the rear end of said housing, an electric motor mounted within said housing and having a motor shaft drivingly connected to said cutting mechanism, a bearing carried by said cover for rotatably supporting one end of said motor shaft, a commutator ring mounted on said shaft adjacent said bearing, first and second spaced apart brushes engaging said commutator ring, means on said cover for supporting said brushes for limited movement radially of said ring, first and second electrical terminal means carried by said cover, and means for electrically connecting said terminal means to said brushes to supply power to said motor.

10. The apparatus defined by claim 9 wherein said cover includes a central hub portion carrying said bearing, said cover including a pair of spaced apart through openings extending from said hub portion generally radially outward of the axis of the shaft and a brush support mounted in each of said openings to support one of the brushes.

11. The apparatus defined by claim 9 wherein said cover includes a pair of spaced apart through openings extending generally radially outward of the axis of said shaft, an open sided channel mounted in each of said openings, said terminal means respectively including members closing the open sides of the channels to provide a retainer for the brushes.

12. In an electric hair clipper including a housing, an electric motor within the housing, and a switch for controlling the operation of said motor the improvement which comprises, a switch operator mounted on the housing for movement between on and off positions, a switch blade attached to said switch operator and movable therewith, a first flexible switch arm extending away from said switch operator, a first fixed terminal engaged by said first switch arm, a second flexible switch arm extending adjacent and generally parallel to the first switch arm, a second fixed terminal adjacent to but spaced from the first terminal and engaging said second switch arm when the switch operator is in the on position, thereby to connect said first and second terminals through the switch blade, said second switch arm engaging said first fixed terminal to flex said arm out of engagement with said second terminal when said switch operator is in the off position, thereby to break the circuit between the first and second terminals.

13. The apparatus defined by claim 12 wherein the switch blade includes a flexible detent arm extending

away from said switch operator and away from said first and second switch arms, and detent means engaged by said detent arm to hold said switch operator in at least one of said positions.

14. An electric hair clipper comprising a motor housing having front and rear ends; a cutting mechanism supported adjacent the front end of said housing; an electric motor within the housing and including an outer stator ring, a pair of permanent magnet pole pieces within and adjacent to the ring and spaced apart to form a pair of gaps, an armature disposed concentrically with respect to the pole pieces and the ring and mounted upon an armature shaft, a commutator ring electrically connected to the armature and carried by said shaft adjacent the rear end of the motor housing, a front cover member secured to the front end of said housing, a front bearing carried by the front cover for rotatably supporting one end of the armature shaft, a rear cover for the housing, a pair of elongated screws respectively extending through said gaps to detachably secure the rear cover to the front cover, and a rear bearing carried by the rear cover for rotatably supporting the end of the armature shaft adjacent the commutator ring.

15. An electric hair clipper comprising a first housing having front and rear ends; a cutting mechanism supported adjacent the front end of said first housing; an electric motor within the first housing and including an outer stator ring, a pair of permanent magnet pole pieces within and adjacent to the ring spaced apart to form a pair of gaps, an armature disposed concentrically with respect to the pole pieces and the ring and mounted upon an armature shaft, and a commutator ring electrically connected to the armature and carried by said shaft adjacent the rear end of the first housing; a front cover member secured to the front end of said first housing; a drive mechanism connecting said shaft to said cutter mechanism; a front bearing carried by the front cover for rotatably supporting one end of the armature shaft; a rear cover for the first housing; a pair of elongated screws respectively extending through said gaps to detachably secure the rear cover to the front cover; a rear bearing carried by the rear cover for rotatably supporting the end of the armature shaft adjacent the commutator ring; a pair of spaced apart brushes engaging said commutator ring and each mounted for movement upon said rear cover in a direction extending generally radially of said shaft; a first pair of electrical terminal means on said first unit; means including a manually operated switch for electrically connecting said first pair of terminal means to said brushes; a second housing detachably secured to said first housing and including a second pair of electrical terminal means; each terminal means of one of said pairs including a flexible contact and each of the terminal means of the other pair including a fixed contact member; each of said flexible contacts engaging one of said fixed contacts to apply a mechanical force for holding said first and second housings together and for establishing electrical connections between the two housings.

16. The apparatus defined by claim 15 wherein said cutting mechanism includes a cutter reciprocally mounted for movement within a plane extending transversely of the axis of said shaft; said drive mechanism comprising a drive arm mounted for pivotal movement upon said first housing about an axis extending parallel to but displaced from the axis of said shaft, said drive arm including a body portion carrying a member engaging said cutter at a position remote from the pivot axis, a crank including an eccentric mounted on said shaft, a connecting link engaging said crank and connected to said drive arm at a point intermediate said pivot axis and said member to pivot said drive arm about said pivot axis as said crank is turned with said shaft and said connecting link including means for engaging said eccentric to permit limited movement of said crank relative to said drive arm in a direction extending axially of the shaft.

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17. The apparatus defined by claim 16 wherein said connecting link comprises a member having two spaced openings therein having parallel axes, one of said openings accommodating said eccentric, and a pin carried by said drive arm at said point and extending into the other of said openings.

18. The apparatus defined by claim 15 wherein said rear cover includes a central hub portion carrying said rear bearing, said cover including a pair of spaced apart through openings extending from said hub portion generally radially outward of the axis of the shaft and a brush support mounted in each of said openings to support one of the brushes.

19. The apparatus defined by claim 18 wherein each brush support comprises an open sided channel mounted in one of said openings, said first pair of terminal means respectively including members closing the open sides of the channels to provide a retainer for the brushes.

20. The apparatus defined by claim 15 wherein said switch comprises a switch operator mounted on the first housing for movement between on and off positions, a switch blade attached to said switch operator and moveable therewith, a first flexible switch arm extending away from said switch operator and engaging one of the terminal means of the first pair, said one terminal means being formed on one of said elongated screws, a second flexible switch arm extending adjacent and generally parallel to the first switch arm to engage the other terminal means of the first pair when the switch operator is in the on position, thereby to connect the terminal means of the first pair through the switch blade, said second switch arm engaging said one terminal means to flex said arm out of engagement with said other terminal means when said switch operator is in the off position, thereby to break the circuit between the terminal means of the first pair.

21. The apparatus defined by claim 20 wherein the switch blade includes a flexible detent arm extending away from said switch operator and away from said first and second switch arms, and means on said first housing engaged by said detent arm to hold said switch operator in at least one of said positions.

22. An electric hair clipper comprising a housing having front and rear ends, cutting mechanism mounted on said housing adjacent said front end, a cover detachably secured to the rear end of said housing, an electric motor mounted within said housing and having a motor shaft drivingly connected to said cutting mechanism, a commutator ring mounted on said shaft adjacent said cover,

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first and second spaced apart brushes engaging said commutator ring, first and second electrical terminal means carried by said cover, and means for electrically connecting said terminal means to said brushes to supply power to said motor, the last named means including a fastener for securing said cover to said housing and electrically connected to one of said brushes and to the first terminal means, and a switch having a first switch arm engaging said fastener, and having a second arm electrically connected to the second terminal means.

23. An electric hair clipper comprising a first housing having front and rear ends; a cutting mechanism supported adjacent the front end of said first housing; an electric motor within the first housing and including an outer stator ring, a pair of permanent magnet pole pieces within and adjacent to the ring and spaced apart to form a pair of gaps, an armature disposed concentrically with respect to the pole pieces and the ring and mounted upon an armature shaft, a front cover member secured to the front end of said first housing; a drive mechanism connecting said shaft to said cutter mechanism; a rear cover for the first housing to detachably secure the rear cover to the front cover; a first pair of electrical terminal means on said first unit; means including a manually operated switch for electrically connecting said first pair of terminal means to said motor; a second housing detachably secured to said first housing and including a second pair of electrical terminal means; each terminal means of one of said pairs including a flexible contact and each of the terminal means of the other pair including a fixed contact member, each of said flexible contacts engaging one of said fixed contacts to apply a mechanical force for holding said first and second housing together and for establishing electrical connections between the two housings.

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ROBERT C. RIORDON, Primary Examiner

J. C. PETERS, Assistant Examiner

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