Dec. 13, 1966 G. P. KRATZ 3,290,781

LIGHT-WEIGHT CUTTER BLOCK FOR ELECTRIC SHAVER AND METHOD OF MANUFACTURE

Filed Dec. 9, 1963 3 Sheets-Sheet 1

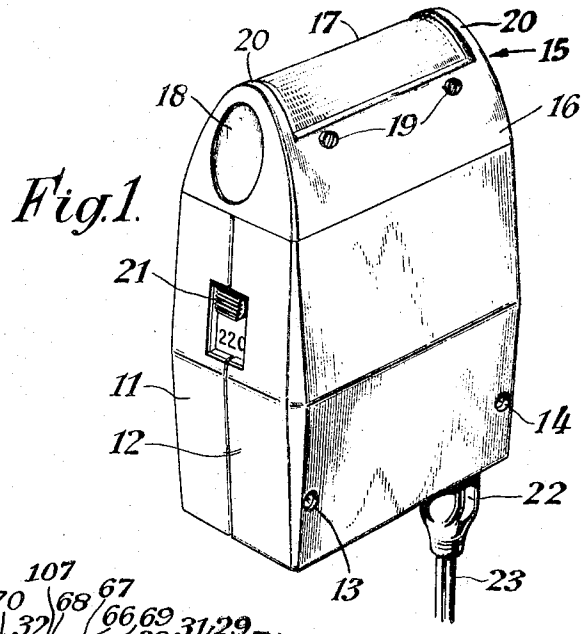


Fig. 1.

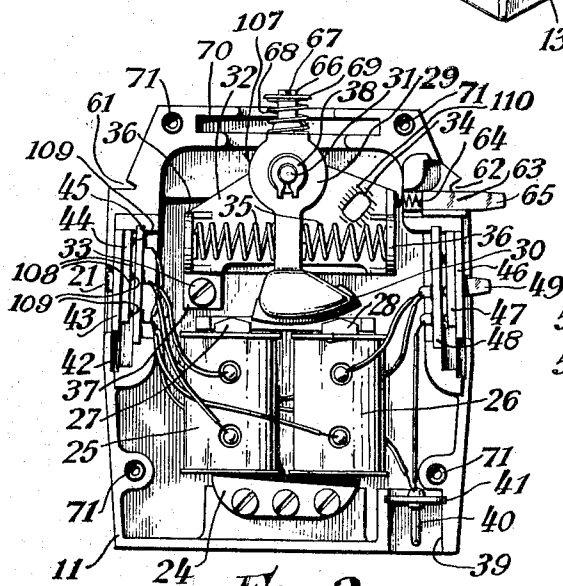


Fig. 2.

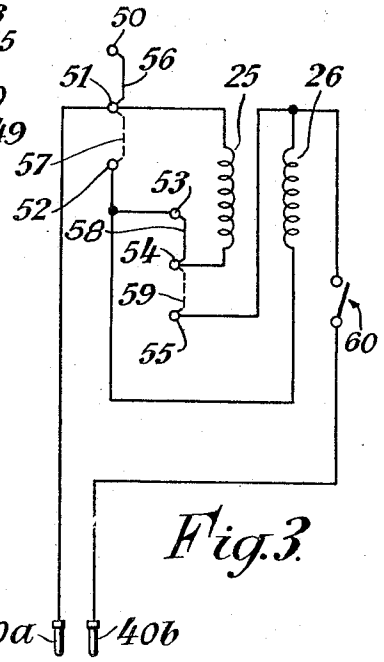


Fig. 3.

40a 40b

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Fig. 4.

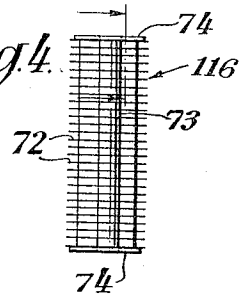
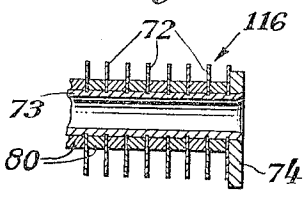


Fig. 5.



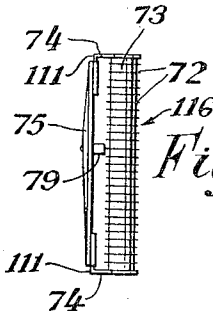


Fig. 6.

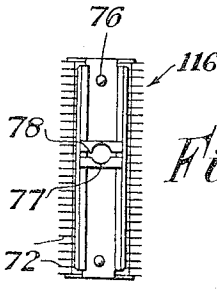


Fig. 7.

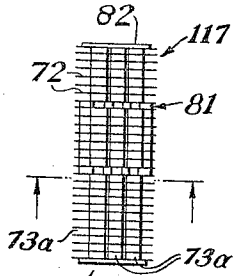


Fig. 8.

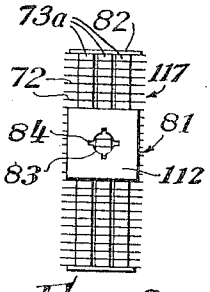


Fig. 9.

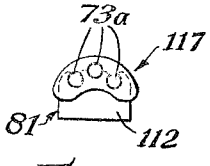


Fig. 10.

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LIGHT-WEIGHT CUTTER BLOCK FOR ELECTRIC SHAVER AND METHOD OF MANUFACTURE

Filed Dec. 9, 1963 3 Sheets-Sheet 3

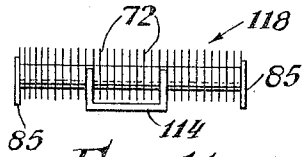


Fig. 11.

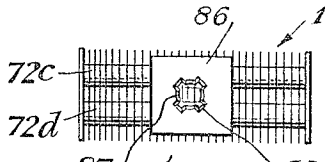


Fig. 12.

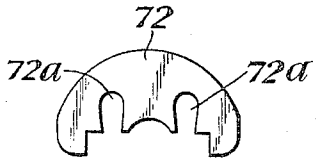


Fig. 13.

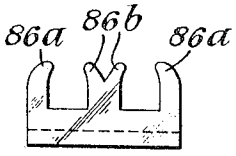


Fig. 14.

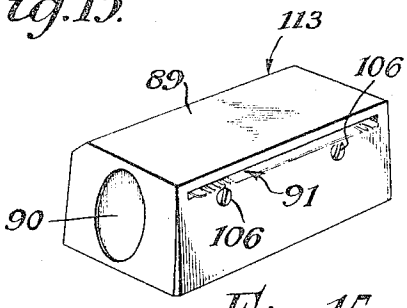


Fig. 15.

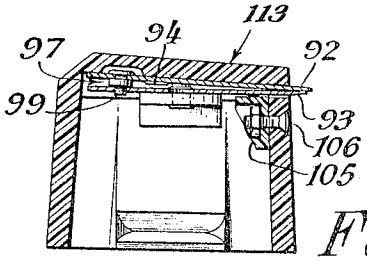


Fig. 17.

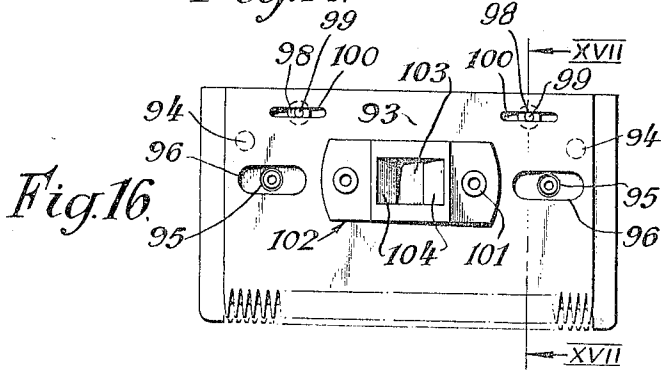


Fig. 16.

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LIGHT-WEIGHT CUTTER BLOCK FOR ELECTRIC SHAVER AND METHOD OF MANUFACTURE

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Claims priority, application Germany, June 14, 1963, L 45,100
1 Claim. (Cl. 30—346.51)

This invention relates generally to electric shavers, and more particularly to an electric shaver of the type in which a cutter block is reciprocated with respect to a stationary cutter foil by means of an oscillating armature motor energized by alternating current.

In known forms of electric shaver the shaving head frequently comprises a cutter foil, which is a thin perforated sheet of springy steel, and a cutter block which contains a number of cutter blades and is held in contact with the cutter foil while being reciprocated with respect thereto, the passage of the cutter blades over the edges of the perforations producing a shearing action. These known electric shavers are frequently driven by rotating motors so that mechanism is necessary to convert the rotary output of the motor to the reciprocating movement required by the cutter block. Such motors may be made for D.C. and A.C. operation.

As an alternative to the rotating motor, an oscillating armature motor may be employed, comprising an armature which is held in a chosen dead-centre position by springs, a part of the armature lying within an air gap in a field magnet and so positioned that when alternating current is applied to the winding the armature oscillates. This type of motor will only operate on alternating current, but it eliminates lubrication and other problems which arise with the rotary motor, and no rotary-to-reciprocating movement conversion is required since the oscillating armature motor naturally provides a reciprocating output.

Known types of electric shavers incorporating oscillating armature motors have been subject to undesirable noise and vibration during operation. The cutter block is normally constructed entirely of metal and its reciprocation therefore requires a comparatively powerful motor, since substantial masses must be rapidly reciprocated. In known types of shavers the mechanical parts are made of metal and these transmit noise very efficiently.

Accordingly, one object of the present invention is to provide an improved electric shaver having an oscillating armature motor and a cutter block which is of light-weight construction so that vibration is reduced to a minimum.

Another object of the invention is to provide an electric shaver in which the oscillating armature of the motor is substantially isolated from the casing and from the cutter block by synthetic plastic materials which have low noise transmission characteristics.

A further object is to produce an electric shaver having an interchangeable clipper head which can readily be fitted in place of the shaver head.

The invention consists of an electric shaver for use with an alternating current supply comprising a casing, a magnetic circuit provided with an air gap and a winding for energization by alternating current mounted inside the casing, an oscillating armature carried on a pivot pin attached to a mounting plate adjustably secured in the casing, the armature being constructed of synthetic plastic material apart from a magnetic shoe lying close to the said air gap, a coupling pin on the armature projecting out of the casing for engaging a cutter block, the armature magnetic shoe being so positioned that energization of the winding causes the armature to oscillate at a frequency related to the supply frequency, a cutter head attachable to the casing containing a perforated cutter foil, a built-up light-weight cutter block comprising a coupling member preferably made of synthetic plastic material engageable by the coupling pin for reciprocation thereby, and a spring to urge the cutter block into contact with the perforated cutter foil.

Preferably the mounting plate is located with respect to the casing by a locating pin co-axial with the armature pivot pin, the locating pin engaging an opening formed in the casing, the mounting plate being retained by two screws passing through elongated slots in the mounting plate into the base plate, the longer axes of the slots being tangential to arcs centred on the pivot pin axis, whereby the air gap and dead-centre position of the oscillating armature may be adjusted with respect to the magnetic circuit.

The cutter block is preferably built up of one or more support members each comprising a thin tube which is passed through holes in cutter blades arranged side by side in a spaced row, the cutter blades being fixed to the carrier member by expanding the tube. The cutter block is provided with a coupling member for engagement by the coupling pin of the oscillating armature, the coupling member being preferably made of synthetic plastic material.

Preferred embodiments of the invention will now be described with reference to the accompanying drawings in which—

FIGURE 1 is an exterior view of an electric shaver according to the invention;

FIGURE 2 is an elevation of one half of the casing of the shaver of FIGURE 1 showing the mechanism mounted therein, but with the cutter head and cutter block removed;

FIGURE 3 is a circuit diagram of the electrical connections within the shaver;

FIGURES 4 to 7 show one form of cutter block according to the invention;

FIGURES 8 to 10 show another form of cutter block;

FIGURES 11 to 14 show still a further form of cutter block;

FIGURE 15 is an external view of a clipper head for mounting on the shaver in place of the shaver head;

FIGURE 16 is a view looking into the clipper head of FIGURE 15, with the sides of the clipper head casing removed, to show the mounting of the operative parts of the clipper clearly; and

FIGURE 17 is a sectional elevation of the clipper head of FIGURE 15 taken on the line XVII—XVII of FIGURE 16.

Referring now to the drawings, FIGURE 1 shows that the shaver casing consists of two parts, respectively **11** and **12**, which are held together by two screws contained in counterbores **13** and **14** in the part **12** and screwing into screw-threaded inserts (shown in FIGURE 2) moulded into the part **11**. Two further screws at the head end of the casing are covered by the shaver head, generally indicated by reference **15**, in FIGURE 1. The shaver head **15** comprises a hollow shell **16** adapted to fit over the ends of the assembled casing, and is held in position by a spring latch to be described later. The two ends of the shell **16** contain rounded depressions **18** which provide a thumb and finger grip for attaching and removing the head. The perforated cutter foil **17** is attached to the shell **16** by means of two screws **19** on one side and two similar screws at the other side which are not visible in FIGURE 1. The cutter foil **17** lies between the ends **20** of the shell **16** and is just out of contact, so that it is capable of flexing to conform to the shape of a cutter block, to be described later, which is spring-pressed into contact with the cutter foil

17. The cutter foil 17 contains a large number of perforations arranged in any convenient pattern, the edges of the perforations forming shearing edges which co-operate with the shearing edges of the cutter block.

At one end of the casing is the button 21 of a switch by which the internal circuits of the shaver may be adjusted to suit either one of two voltages.

The foot end of the casing is formed with an opening containing two contact pins to engage a socket 22 on the end of a supply cable 23.

FIGURE 2 shows the casing part 11, which is moulded from synthetic plastic material suitably formed and provided with screw-threaded moulded-in metal inserts, so that the various parts of the shaver may be located and secured within it, the casing part 12 serving merely as a cover. The casing part 11 forms a base plate upon which the parts of the reciprocating armature motor are mounted. The motor comprises a laminated magnetic core 24 having two limbs carrying windings, respectively 25 and 26, which are adapted to be energized by alternating current. The two limbs terminate in inverted-V shaped ends, respectively 27 and 28. An oscillating armature generally indicated by reference 107, comprises a body 29 which is made of synthetic plastic material and is provided with a laminated magnetic armature shoe 30. It is supported on a pivot pin 31 and retained by a circlip 38, while the pin 31 is fixed to a mounting plate 32, and a locating pin (not shown) concentric with the pivot pin 31 projects from the under side of the mounting plate 32 to engage a hole (not shown) formed in the casing part 11. Thus, the armature body 29 is capable of rotary oscillation about the pivot pin 31 and the mounting plate 32 may swing about the same axis. The mounting plate 32 is secured by two screws, one of which, 33, is shown in position. Both screws pass through elongated slots, of which one is indicated by reference 34, and thence into moulded-in screw-threaded inserts (not visible) in the casing part 11. The two slots are arranged so that their long axes are tangential to arcs struck from the axis of the pivot pin 31. The screw 33 passes through a portion 37 of the mounting plate which is raised above the main portion thereof, so that when the screw 33 is tightened down the portion 37 yields slightly, which assists in preventing subsequent loosening.

Two armature return springs 35 bear respectively upon the two sides of the armature body 29 and are supported at their other ends by portions 36 of the mounting plate 32 which are bent upwardly at right angles.

The armature body 29 rests in a dead-centre position which is determined by the two springs 35 and which must be correctly adjusted with respect to the edge of the pole limb 27. This is achieved by slightly loosening the screw 33 and its companion and rocking the mounting plate aobut the axis of the pivot pin 31 until the correct adjustment is secured. The screw 33 and its companion screw are then tightened down. In order that these screws may be secure when tightened the surface of the metal of the mounting plate around the slot 34 and its companion slot are roughened at 110 to provide a good grip for the screw head.

The socket connector 22 (FIGURE 1) passes into an opening 39 at the foot of the casing part 11 to engage a pair of contact pins 40 carried on an insulating plate 41 located in slots in the casing part 11. On the left-hand side of the casing part 11 is a slot 42 in which slides an insulating plate 43 carrying the projection 21 (FIGURE 1) which does not extend beyond the surfaces of the casing parts 11 and 12 to prevent accidental movement. It is ridged so that it may readily be slid up and down. The plate 43 has a rear portion 44 which carries two contact springs 108 engaging fixed contacts 109 carried on an insulating plate 45 set in a slot in the casing part 11. The moving contact springs and the fixed contacts together constitute a double-pole changeover switch. A similar arrangement is fitted to the right-hand part of the casing part 11, comprising the sliding plate 46 with the rear portion 47 and the fixed contact plate 48. In this case the portion 49 extends outwardly of the casing walls for easy manipulation by the user's thumb or finger. This switch is connected as an on-off switch.

FIGURE 3 shows the circuitry inside the shaver, the two connecting pins 40 being given references 40*a* and 40*b* to facilitate description. The double-pole changeover switch, parts 42 to 45, 108 and 109 in FIGURE 2, comprises fixed contacts 50, 51 and 52, and fixed contacts 53, 54 and 55. The movable contact spring co-operating fixed contacts 50 to 52 is shown as a solid line 56 in its one position and as a dotted line 57 in its other position, while the movable contact spring co-operating with fixed contacts 53 to 55 is shown as a solid line 58 in its one position and as a dotted line 59 in its other position. The on-off switch comprising members 46 to 48 is indicated by a new reference 60. With the changeover switch in the one position, indicated by the solid lines 56 and 58, current passes from contact pin 40*a* to fixed contact 51, through winding 25 to fixed contact 54, through contact spring 58 to fixed contact 53, through winding 26, through switch 60 and to contact pin 40*b*. The two windings 25 and 26 are thus in series and the razor is suitable for connection to, for example, a 220 volt supply, such as is used in European countries. With the changeover switch in the other position, indicated by the dotted lines 57 and 59, current passes from contact pin 40*a* to fixed contact 51 and then divides. One path is from fixed contact 51 through winding 25 to fixed contact 54, through contact spring 59 to fixed contact 55, thence to switch 60. The other path is from fixed contact 51 through contact spring 57 to fixed contact 52, through winding 26 and to switch 60, the combined current then passing from switch 60 to contact pin 40*b*. The two windings are now in parallel and therefore suitable for connection to a supply of 110 volts, as used in the United States of America and Canada.

When the windings 25 and 26 are energized a magnetic field builds up in the core 24 during the first half-cycle of current and the armature shoe 36 is pulled to the left in FIGURE 2, against the force of the left-hand spring 35 and with the assistance of the right-hand spring 35. When the half-cycle passes its peak the armature shoe 30 is pushed back to (and beyond) its dead-centre position by the action of the springs 35. When the second half-cycle of current begins to build up the armature shoe 30 is again pulled to the left in FIGURE 2 by the new field which builds up in the opposite direction in the core 24. Since neither the core 24 nor the armature shoe 30 are polarized the pull on the armature shoe 30 is in the same direction. Consequently the armature 29 oscillates at double the supply frequency.

The shaver head is held in position on the assembled casing by a V-shaped latch projection (not visible) formed inside the shell 16 which engages in a V-slot 61 on one side of the casing and, on the other side, by a similar latch projection in the shell which engages in a V-slot 62 formed on a sliding latch 63 carried in grooves in the casing and urged outwardly by a spring 64. The latch 63 has an extension 65 to enable it to be pressed inwardly to release the shaver head 15.

A coupling pin 66 is moulded into the armature body 29 at the opposite end to the shoe 30 to engage the reciprocatory cutter block. Fixed in the outer end of the coupling pin 66 is a cross pin 67 which projects from the coupling pin at both ends. A spring 68 is seated on a shoulder formed on the armature body and bears upon a cupped washer 69 which locates the spring centrally and abuts the cross pin 67.

The casing part 11 is formed with a groove 70 to accommodate a strip of foamed plastic or the like which fits around the spring 68 to prevent the entry of foreign matter into the mechanism. The casing part 11 is also pro-

vided with four moulded-in screw-threaded inserts **71** to accommodate the four fixing screws previously referred to.

One form of cutter block according to the invention, having reference **116**, is shown in FIGURES 4 to 7 which are respectively a plan, an enlarged section of a part of the cutter block, a side elevation and an inverted plan. As shown in these figures, the cutter block comprises a number of cutter blades **72** disposed in a row or stack spaced apart from each other. In cutter blocks of this type the blades must be maintained perpendicular to the co-operating surface of the cutter foil. A known method of constructing them is to form the cutter blades with holes and thread them on to a rod with spacer pieces or rings between them. The cutter blades may then be fixed, for example, by deforming the spacing pieces, which is an inconvenient manufacturing operation and is not fully reliable functionally. Another known method is to hold the blades in their correct respective positions and to form a base on the blades by casting. This makes a heavy structure, even if the base is made of light metal. A coupling member is provided either cast on or attached in the one case, or attached in the other case, the coupling member being of metal. In the structure according to the invention the blades **72** are threaded on to a tube **73**, the blades being formed with holes which fit snugly around the tube, and when in position the tube **73** is expanded by mechanical, hydraulic or other means, so that the blades **72** become embedded to a small depth in the tube itself, as indicated in FIGURE 5. They are thus securely and permanently held in their correct positions. A rigid structure having the lowest possible weight is thereby provided. End plates **74** may be attached, also by expanding the tube **73**, and in addition by forming chamfers in the outer ends of the holes in the end plates and spinning the tube ends into the chamfers, as is also shown in FIGURE 5.

As shown in FIGURE 6, end plates **74** have extensions **111** turned at right angles to the planes of the cutting blades **72**, and a coupling member **75** is attached by means of rivets **76**. The coupling member is formed at its centre portion with an opening **77** (see FIGURE 7) having two opposite slots **78** in the crosswise direction. The opening **77** is of such size that the coupling pin **66** will pass snugly into it and the ends of the cross pin **67** will pass through the slots. To suit this particular positioning, the cross pin **67** should be orientated through 45° to 90° from the position actually shown in FIGURE 2. To fix the cutter block on to the coupling pin **66** the cutter block is pressed on to the coupling pin **66** so that the ends of the cross pin **67** pass through the slots **78**, the coupling member then pressing upon the dished washer **69** and compressing the spring **68**. When the cross pin **67** has passed right through the thickness of the coupling member **75**, the cutter block is turned, so that it is in line with the cutter head when in position, and released. The spring **68** then expands and pushes the cutter head upwardly until the inner surface of the coupling member engages the ends of the cross pin **67**. The cutter block is retained in that position and the cutter head **15** may be snapped into position over it. When the cutter head is in position the cutter block is pressed back to some degree by the cutter foil to compress the spring **68**, so that the spring serves to maintain close cutting contact between the cutter blades and the cutter foil. The outer curved portions of the cutter blades are carefully ground so that they define a part of a parallel cylinder and, due to its flexibility, the cutter foil is conformed to this cylinder.

By making the coupling member **75** of a light synthetic plastic material the light-weight feature of the cutter block is preserved. To prevent bending of the coupling member by the spring **68**, projections **79** may be formed on the inner face of the coupling member which bear against the ends of the cutter blades **72**.

While spacer pieces between the cutter blades **72** are not essential they may be provided if desired, and are indicated at **80** in FIGURE 5.

In a preferred construction of cutter block, indicated by reference **117** and shown in FIGURES 8 to 10 three tubes **73***a*, arranged to define the three corners of a triangle, in place of the single tube **73**, are used. This provides a much stronger and more rigid construction, while still preserving the feature of very light weight. The cutter blades **72** are each provided with three holes and they are threaded in a spaced row on to three tubes **73**, and these are expanded as previously described in order to lock the cutter blades into position. However, a different and lighter form of coupling member, generally indicated by reference **81**, is shown which is approximately in the form of a U, the projecting bridge portion **112** of the U lying along the underface of the cutter blades and the legs of the U fitting snugly between pairs of adjacent blades, the coupling member being made of a synthetic plastic material. The legs of the U may also be formed to fit around the tubes **73**. FIGURES 8 to 10 do not show a side view of the coupling member **81**, but this is substantially the same as the side view of the coupling member **114** of FIGURE 11. Reverting to FIGURES 8 to 10, it will, of course, be understood that end plates **82** may be fitted to support the end blades **72**. The bridge portion **112** is provided with an opening **83** for the coupling pin **66** and slots **84** to admit the ends of the cross pin **67**.

FIGURES 11 to 14 show a further form of cutter head **118** which comprises cutter blades **72** (FIGURE 13) having slots **72***a* instead of holes. The blades are arranged in a spaced row as before and two carriers **72***c* and **72***d* are formed by casting. The coupling member **86**, while of generally similar form to that shown in FIGURES 8 to 10, has a differently shaped opening consisting of a circle **87** and four slots **88** equally spaced on diagonal lines around the circle. For use with this form of head the cross pin **78** should be in the position shown in FIGURE 2. The cutter block is placed on the coupling pin in such a position that the cross pin will pass through a pair of opposite slots **88** and is then turned through an angle of 45° to bring it into general alignment with the casing before snapping the cutting head into position. The sides of the coupling member are formed into tongues **86***a* and **86***b* (FIGURE 14) and snap over the carrier members **72***c* and **72***d*.

FIGURES 15 to 17 show a clipper head, generally indicated by reference **113**, which may be mounted on the shaver casing in place of the shaving head **15**. It comprises a hollow casing **89**, formed with depressions **90** to provide finger or thumb grips, and adapted to snap on to the casing of the razor in the same way as the shaver head. Projecting from one side of the casing **89** is a clipper **91** consisting of a fixed blade **92** and a reciprocable blade **93**. The blade **92** is held in position by means of two rivets **94** moulded on to the inside of the casing **89**, which pass through holes in the blade **92** and are deformed by the local application of heat to the thermoplastic casing material. The blade **92** is located in position by locating dowels **95** moulded on to the inner part of the casing. The blade **93** is restricted to sideways reciprocating movement with respect to the blade **92** by means of two members **97** riveted on to the blade **92**. These members have relatively large diameter portions **98** which form platforms on which the blade **93** rests and a smaller diameter guide portion **99** projecting through the slots **100**. Riveted to the centre of the blade **93** by rivets **101** (FIGURE 17) is a moulded synthetic plastic coupling member **102** formed with an opening **103** in its centre, with two downwardly bevelled portions **104** at the side of the opening. The opening **103** is of such width as to accept the coupling pin **66** but since the blades **92** and **93** are not loose the cross pin **97** need not

be used; it is only necessary to ensure that the spring **68** is compressed to some extent by the coupling member **102**.

In assembling the clipper head the blade **94**, with the member **97** riveted on, is placed inside the casing **89** as described and the rivets referred to are clinched by heat deformation. The blade **93**, with the coupling member **102** riveted to it, is placed in position and located by its slots **100** on the guide portions **99**. A synthetic plastic bar **105** is then placed inside the casing so that it presses lightly upon the blade **93**, and secured by means of two screws **106**.

I claim:

A built-up light-weight cutter block for an electric shaver comprising a plurality of cutter blades each formed with at least one hole and spaced in a row along a tube passing through the holes in the cutter blades, the perimeters of the holes in the cutter blades being embedded in the outer surface of the tube so that the cutter blades are held firmly in position on the tube, a coupling member by which the cutter block may be coupled to driving means in the shaver, an end plate at each end of said row of cutter blades, the end plates having holes the perimeter of which are embedded in the surface of said tube, and angled extensions on said end plates to which said coupling member is attached.

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