

[54] **METHOD OF MAKING OUTER BLADE FOR ELECTRIC SHAVER**

[75] Inventors: Yoshimitsu Nakamura, Settsu;
Mitsuo Sugioka, Neyagawa,
both of Osaka, Japan

[73] Assignee: Matsushita Electric Works, Ltd.,
Osaka, Japan

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[52] U.S. Cl. 76/104 R

[51] Int. Cl. B21k 11/00

[58] Field of Search 76/104 R, 101 A, 101 SM

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Primary Examiner—Harrison L. Hinson

Attorney, Agent, or Firm—Pierce, Scheffler & Parker

[57] **ABSTRACT**

A method of making substantially a spherical outer blade for rotary electric shavers which is countersunk smoothly around hair inlet holes. A die having alternate and continuous convex and concave parts is used, either one of which convex and concave parts correspond to the hair inlet holes and are provided with a curved surface of desired radius of curvature at a shoulder part of each convex part. A metal lamina placed between the die and a soft plate material is pressed so as to be plastically deformed conforming to the die surface, and the deformed lamina is subjected to mechanical, chemical or electrochemical grinding to form the hair inlet holes.

5 Claims, 21 Drawing Figures

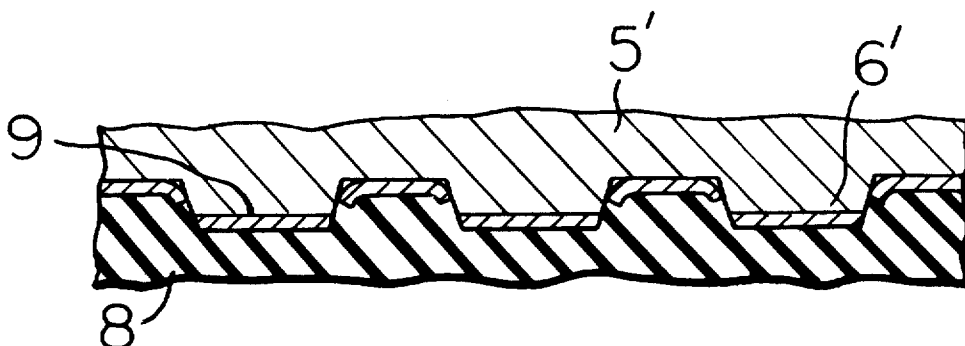


Fig. 1A

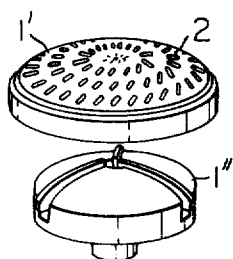


Fig. 1B

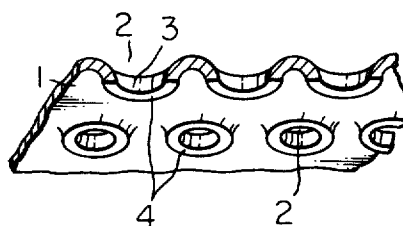


Fig. 2A

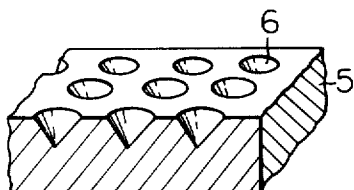


Fig. 2B

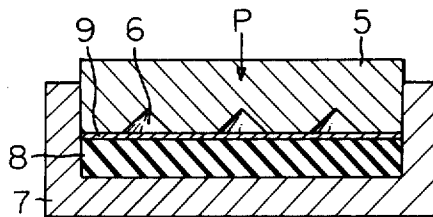


Fig. 3A

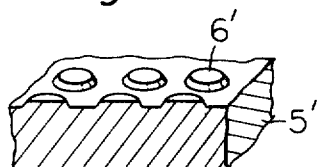


Fig. 2C

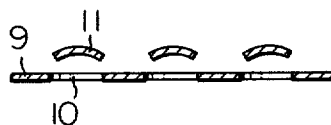


Fig. 3B

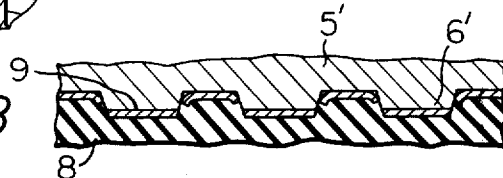


Fig. 3C

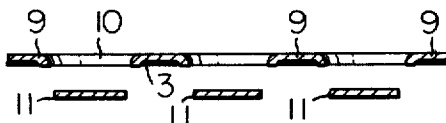


Fig. 3D

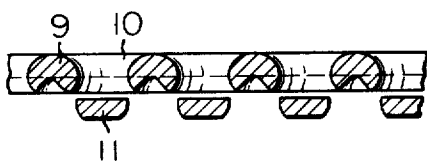


Fig. 3E

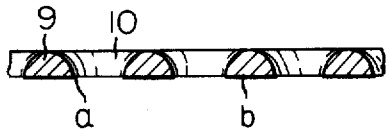


Fig. 3F

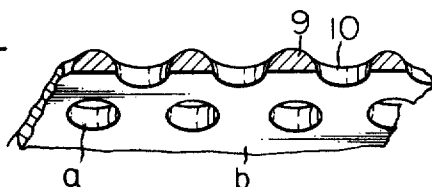


Fig. 4A

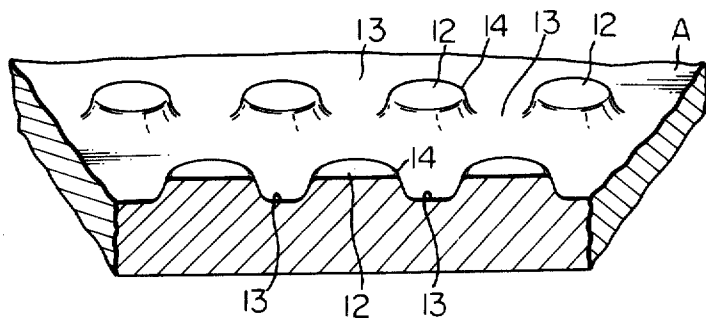


Fig. 4B

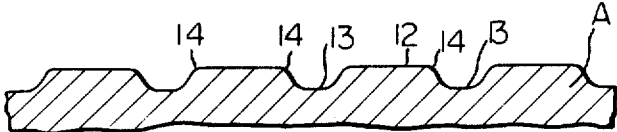


Fig. 4C

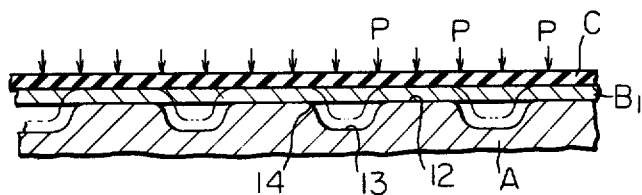


Fig. 4D

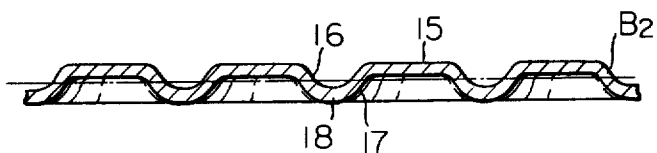


Fig. 4E

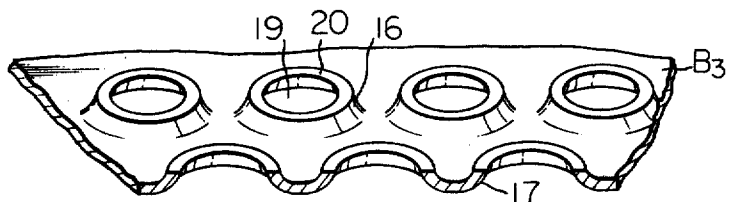


Fig. 5A

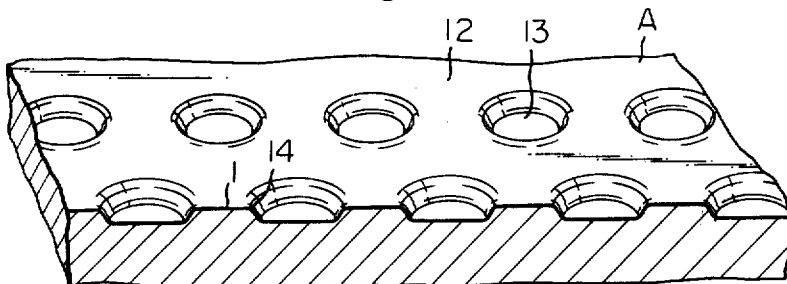


Fig. 5B

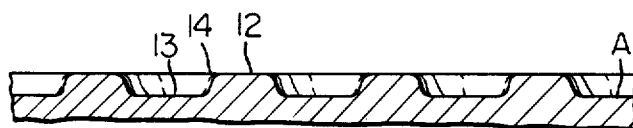


Fig. 5C

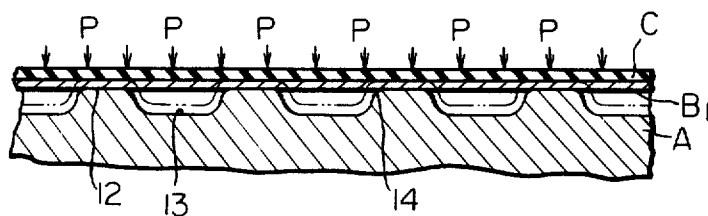


Fig. 5D

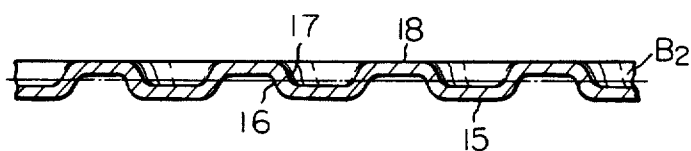
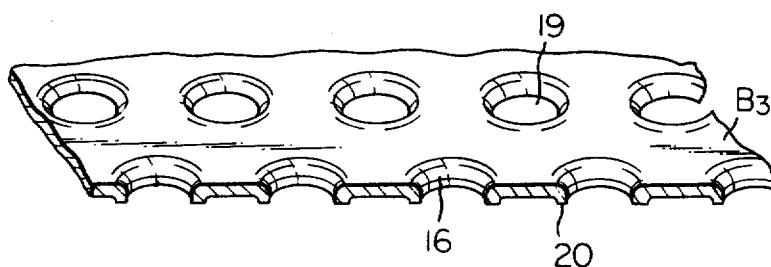


Fig. 5E



METHOD OF MAKING OUTER BLADE FOR ELECTRIC SHAVER

This invention relates to methods of making outer blades for electric shavers and, more particularly, to a method of making a substantially spherical outer blade for rotary electric shavers which is countersunk around hair inlet holes.

A method of making outer blades for electric shavers wherein such rolled material as, for example, of a stainless steel is mechanically sheared and punched by using a punch or ram of such soft material as rubber and a metal die having conical concave parts formed in the parts corresponding to the respective holes of the outer blade is known, for example, with Austrian patent No. 42633. According to said method, when the material is so thin as to be, for example, less than 0.05 mm. thick, an outer blade of a required cross-sectioned shape will be obtained but, when it is so thick as to be 0.07 to 0.10 mm. thick, the outer blade will be improved with respect to its strength but, when it is made by the punching process, the cutting blade edge angle will become rectangular or obtuse and the countersunk layers will be likely to be unbalanced around the hair inlet holes.

In order to eliminate the above mentioned defects, there is suggested Japanese patent publication No. 836/1964. This is a method wherein a rolled material is pressed and punched between a tapered convex die and a soft material. However, said method, too, likewise in the preceding method, is applicable to thin materials but is difficult to apply to materials 0.08 to 0.10 mm. thick. The present invention is suggested to eliminate these defects in known methods.

According to the present invention, a metal lamina is arranged between a die having a curved surface of a desired radius of curvature on the shoulder part of each of the convex parts and a ram made of a soft material, either the die or the ram being pressed so that the metal lamina will be plastically deformed to conform to the surface shape of the die and that a concavoconvex outer blade material which is neither sheared nor broken will be formed and thus outer blades of electric shavers can be successfully made of a metal material having a sufficient thickness.

A main object of the present invention is to provide a method of making outer blades for electric shavers wherein punching chips of a metal material are not produced in the metal die in the pressing operation, whereby it is made unnecessary to clean the metal die in each pressing operation and outer blades of a favorable quality can be continuously produced.

Another object of the present invention is to provide a method of making outer blades for electric shavers wherein it is easy to extract a metal material out of the die after the pressing operation and the outer blades will be little deformed at the time of separating them from the die.

A further object of the present invention is to provide a method of making outer blades for electric shavers wherein, even if the outer blade is of a composite pattern containing round holes or rectangular slits, the die separating operation will be easy.

Another object of the present invention is to provide a method of making outer blades for electric shavers wherein either a convex die or a concave die can be used for the metal die.

A further object of the present invention is to provide a method of making outer blades for electric shavers wherein, as the shoulder part of the convex part is rounded, the same die can be used for a long time.

Other objects of the present invention will be understood from the description in the specification.

Now the present invention shall be explained with reference to the accompanying drawings, in which:

FIGS. 1A and 1B show an outer blade and inner blade for rotary electric shavers according to the present invention;

FIGS. 2A to 2C and 3A to 3F show known methods of making outer blades for electric shavers;

FIGS. 4A to 4E show an embodiment of the present invention;

FIGS. 5A to 5E show another embodiment of the present invention.

In FIG. 1A, an outer stationary blade 1' made according to the present invention and a rotary inner blade assembly 1'' for cutting or shaving hairs cooperating with the outer blade are shown in perspective view. In FIG. 1B, a fragmentary part of the outer blade 1' seen from inner side is shown in perspective view, wherein 1 is a plate-shaped metal material which is practically 0.08 to 0.10 mm. thick in the present invention, 2 is a hair inlet through hole and a countersunk part 3 is formed around the hole 2 so that inner blades in the rotary inner blade assembly 1'' will rotate in contact with lands 4 on the inner surfaces of the respective countersunk parts 3 and hairs coming into the respective through holes 3 will be cut off. It is necessary to form such countersunk parts on the outer blade for electric shavers so that, by the presence of the countersunk parts, the hair cutting efficiency will be improved, the friction causing part between the inner blades and outer blade will be decreased, the friction loss will be thus reduced and the energy consumption will be effectively made small.

FIGS. 2A-2C show an embodiment of the above described Austrian patent No. 42633. FIG. 2A is a perspective view of a metal die formed as a concave die 5, in which a large number of inverted conical concave parts 6 is formed. FIG. 2B shows the method of making outer blades according to the Austrian patent wherein, when such soft material 8 as rubber is contained in a case 7, a plate-shaped metal material 9 is mounted on the upper surface of the soft material 8, the concave die 5 is placed on said metal material 9 and they are pressed with any desired pressure P from above, the parts corresponding to the concave parts 6 will be punched off to make holes 10 in the metal material 9 as in FIG. 2C. In such case, chips 11 will accumulate in the concave part in the concave die. According to this method, as illustrated, no countersunk part is formed on the outer blade and, therefore, as described above, the outer blade is not desirable for shavers.

FIGS. 3A to 3F show an embodiment according to the Japanese patent publication No. 836/1964 (corresponding to Austrian patent No. 103830). FIG. 3A shows a metal die formed as a convex die 5' to be used therefor. Many truncated conical convex parts 6' are formed on the upper surface of the metal die 5'.

FIG. 3B shows the method employing the above metal die 5', wherein a metal material 9 is placed on such soft material 8 as rubber and the convex die is mounted on the metal material 9 and they are pressed from above. As a result, as shown in FIG. 3C, the parts

corresponding to the convex parts 6' will be punched out to form through holes 10 and countersunk parts 3 will be formed around the respective through holes. In this method, metal materials of 0.04 to 0.06 mm. thick are mostly used. However, according to this method, as the parts of the through holes are punched through by a pressing operation, if the metal material is more than 0.08 mm. thick, in case the intervals and areas of the through holes are of the average values of ordinary shavers, the metal material worked during the pressing operation will be sheared or broken in such form as in FIG. 3D. Therefore, in order that the cutting edge parts of the outer blade body for electric shavers will be formed to be of an acute angle as indicated at *a* in FIG. 3E, elongated sections around the respective holes 10 will have to be removed by grinding up to the original surface shown by the dotted line in FIG. 3D and, as a result, there will be defects that the surface *b* of the outer blade body to be in sliding contact with the rotary inner blades will become flat, that the sliding contact area between the inner blades and outer blade will become larger, that the load imparted to the rotary inner blade assembly will become larger and that the wear of the inner blades will also become larger. As described above, the present invention is suggested to solve these defects.

The features of the present invention are first that, in the case of using a convex die, a die in which a curved surface having a desired radius of curvature is formed in the shoulder part of each of the convex parts is used, second that, in the case of pressing the die against a metal material, a metal lamina is plastically deformed so as to conform to the surface of the die and is deformed to be concavo-convex so as not to be sheared and broken and third that, in the metal lamina, projecting convex parts corresponding to the respective through holes are removed by grinding. There are also features that it is not necessary to dispose of chips punched off the parts corresponding to the respective hair inlet through holes, that the pressing operation can be performed efficiently and that, as the die to be used is provided with a curved surface in advance, the wear of the shoulder parts of the die is less than that of the punching die and the life of the die is longer. Further, as there is no punching irregularity, there is an effect that an outer blade in which the countersunk amount is uniform, the cutting blade edge angle is so acute as to be from 50° to 70° and the scooping surface precision of the cutting blade edge is high and can be obtained easily at a low cost. Outer blades for shavers having countersunk parts can be made also of rather thick metal materials without shearing and breaking them.

The present invention shall be explained more particularly with reference to the drawings.

FIG. 4A shows a die A to be used in the present invention, wherein the parts corresponding to the hair inlet through holes of the outer blade for electric shavers are made to be convex parts 12, the parts between the convex parts are made concave parts 13 and curved surfaces 14 of any radius of curvature are formed on the shoulder parts of the respective convex parts 12.

FIG. 4B shows a vertically sectioned view of the die A and FIG. 4C shows the manufacturing steps, wherein a metal lamina B₁ is placed on the upper surface of the die A, a ram C made of such soft material as rubber is placed on the thus set metal lamina B₁ and a pressure

P is made to act on this ram C. Then the metal lamina B₁ will be plastically deformed by the curved surfaces 14 of the shoulder parts of the respective convex parts of the die so as to conform to the shapes of the concave parts 13 without being sheared or broken and, as shown in FIG. 4D, flat parts 15 corresponding the respective hair introducing parts, countersunk parts 16 and projecting parts 18 having respective smooth hair inlet parts 17 will be formed. The outer blade material B₂ thus formed without being punched is removed from the die A and is heat-treated. Then, the flat parts 15 are removed by mechanical grinding with a grindstone or chemical or electrochemical polishing to a position shown by a chain line in FIG. 4D, whereby an outer blade B₃ on which the countersunk parts 16 having cutting blade edges 20 on the peripheral edges of respective hair inlet holes 19 and the smooth hair inlet parts 17 are formed will be obtained. The above is an embodiment in which a convex die is used for the die.

FIGS. 5A-5E show another embodiment in which a concave die is used. As shown in FIG. 5A, there is prepared a die A in which the parts corresponding to the respective hair inlet holes in the product are made to be concave parts 13, the parts between said concave parts 13 are made convex parts 12 and curved surfaces 14 of any desired radius of curvature are provided on the shoulder parts of the respective convex parts or the edge parts of the respective concave parts. FIG. 5B shows a sectioned view of the die. A metal lamina B₁ is mounted between said die and a ram C made of such soft material as rubber and a pressure P is applied to the ram C. If, in this case, such tool steel as, for example, a martensite series stainless steel of about 0.04 to 0.09 mm. thick is used for the metal lamina and such lamina is processed with a die having the radius of curvature at the curved surfaces of the shoulder parts of the convex parts being 0.06 to 0.08 mm. and the depth of the concave part being 0.15 to 0.20 mm. and under a pressure P of 35 to 60 kg./mm.² is made to act through urethane rubber, the metal lamina will be plastically deformed so as to conform to the shapes of the convex parts without being sheared or broken and, the same as in the first embodiment, an outer blade material will be obtained (see FIG. 5C). This pressed outer blade material B₂ removed out of the die A shows such shape as shown in FIG. 5C in section, wherein the parts 15 corresponding to the respective hair inlet parts will be formed in the parts corresponding to the respective concave parts 13 of the die A. Then this outer blade material B₂ is heat-treated and further the parts 15 corresponding to the respective hair inlet holes 19 are electrolytically ground and removed to the position shown with a chain line in FIG. 5D by using a metal bonded diamond hone under the electrolytically grinding conditions of an electrolytic voltage E_o of 10 to 14 volts, electric current *i* of 140 to 200 amperes, cutting depth δ of 0.08 to 0.10 mm. and working velocity V_s of 200 to 300 mm./min. and feeding 3.5 to 4 liters/min. of NaNO₃ (main component) of a concentration of 10 percent to the electrolyte so that hair inlet holes 19 will be formed and, further, the peripheral edges of the respective hair inlet holes 19 are ground by mechanical grinding so that such outer blade B₃ having countersunk parts 16 having the respective cutting blade edge parts 20 and smooth hair inlet parts as is shown in FIG. 5E will be obtained.

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In the above described first and second embodiments, there have been shown methods of making flat plate-shaped outer blades wherein are used dies in which the entire basic surfaces on which convex parts exist are flat. However, if a die in which the entire basic surface is any desired curved surface is used, an outer blade of a curved surface will be able to be made in the same manner as in the above embodiments by simultaneously forming and pressing the curved surface in the same step.

What is claimed is:

1. A method of making outer blades for electric shavers in which a countersunk part having a smooth hair inlet part is formed on the peripheral edge of each of hair inlet holes, comprising steps of preparing a die in which convex parts and concave parts are alternately and continuously formed and a curved surface having any desired radius of curvature is formed on the shoulder part of each of said convex parts, inserting a metal lamina between said die and a plate-shaped soft material, plastically deforming said metal lamina so as to conform to the surface shape of the die, removing thus deformed metal lamina out of the die, and grinding the

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deformed metal lamina so as to form therein hair inlet holes.

2. A method of making outer blades for electric shavers according to claim 1 wherein said convex parts of the die is adapted to correspond to the respective hair inlet holes of the outer blade, said concave parts are formed between the respective convex parts and said curved surface is formed on the shoulder part of each of said convex parts.

3. A method of making outer blades for electric shavers according to claim 1 wherein said concave parts of the die are adapted to correspond to the respective hair inlet holes of the outer blade, said convex parts are formed between the respective concave parts, and said curved surface is formed on the shoulder part of each of the convex parts.

4. A method of making outer blades for electric shavers according to claim 1 wherein said die has a flat basic surface.

5. A method of making outer blades for electric shavers according to claim 1 wherein said die has a curved basic surface.

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