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APPARATUS FOR SHARPENING CUTTING EDGES ELECTROLYTICALLY

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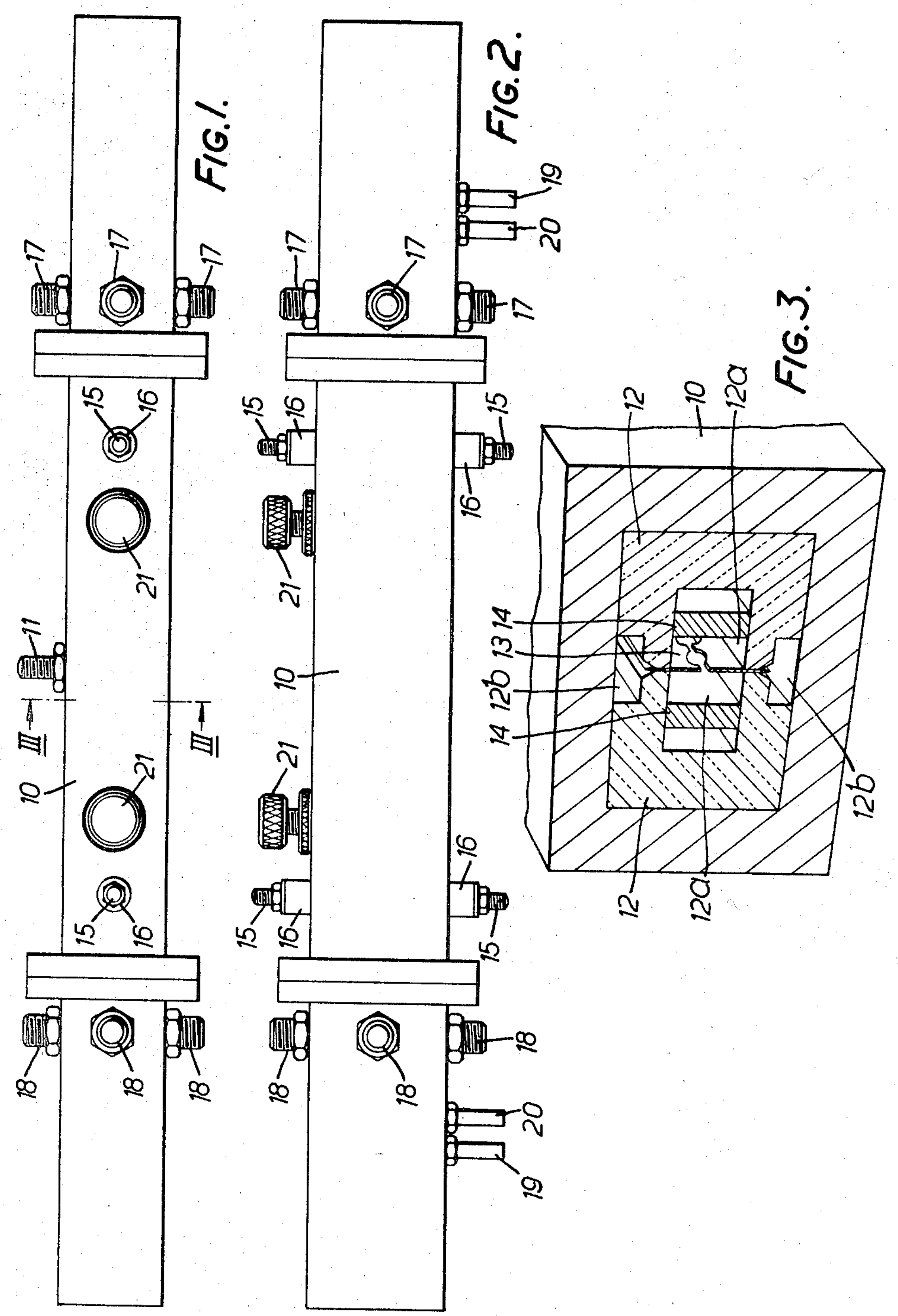

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APPARATUS FOR SHARPENING CUTTING EDGES ELECTROLYTICALLY

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ABSTRACT OF THE DISCLOSURE

An electrolytic cell for electroforming or electrofinishing the cutting edge of a razor blade comprises screening means adjacent which the edge of the razor blade is located, so that the passage of electric current from the razor blade to the cathode of the cell is limited in a differential manner. As a consequence more metal is removed from the tip of the blade and progressively less metal as the distance from the tip increases.

This invention relates to the production of cutting edges and, more particularly, to the production of the cutting edges of razor blades.

The invention employs electrolytic processing in the production of the cutting edges. The electrolytic processes may be used for the finishing, only, of cutting edges after initial formation by other methods, such as abrasive methods, and such processing will be referred to hereafter as "electrofinishing." On the other hand, the processing may be used for production of a cutting edge, without prior mechanical shaping, in which case such processing will be referred to hereafter as "electroforming."

According to the present invention there is provided the method of electroforming of electrofinishing a cutting edge of a razor blade by an electrolytic process, wherein the volume of electrolyte in the region of the blade where the cutting edge is to be produced is restricted, whereby a cutting edge having facets of desired surface contour is formed.

The invention also provides the method of electroforming or electrofinishing the cutting edge of a razor blade in which the razor blade blank is made anodic in an electrolytic cell, wherein the flow of current from the neighbourhood of the blade edge is limited differentially in such a manner that more metal is removed from the tip of the blade than from areas further from the tip.

There is further provided by the invention an electrolytic cell for electroforming or electrofinishing the cutting edge of a razor blade comprising means for limiting the passage of current from the razor blade to the cathode in a differential manner whereby more metal is removed from the tip and progressively less metal as the distance from the tip increases.

One method of performing the invention, an apparatus therefor will now be described by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a side elevation of an electrolytic cell for partial-electroforming or electrofinishing of the cutting edge of a razor blade,

FIG. 2 is an underside plan view of the cell of FIG. 1, and

FIG. 3 is a perspective sectional view through the cell at line III—III in FIG. 1.

The basic cell construction is a modification of the cell described in U.S. patent application Ser. No. 450,718 of B. W. Lovekin filed Apr. 26, 1965 and assigned to the same assignee as is the present application.

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The associated apparatus with which the cell is used for the electroforming or electrofinishing of the cutting edges of razor blades may be as described in the specification of the above-mentioned patent application, more particularly in connection with FIG. 1 of the drawings accompanying that patent application.

Referring now to the accompanying drawings, it will be seen that the cell comprises a metal housing **10** which constitutes the cathode of the cell and which is maintained at earth potential by making an earth connection to earth terminal **11.** Within the cathode housing **10** two screening masks **12, 12** (FIG. 3) of ceramic material are mounted and the adjacent faces of these are separated by a sufficient distance to allow the passage of the metal strip **13**, in the form of razor blade blanks joined end-to-end with central slot already punched. The strip **13** makes a sliding fit with the faces of masks **12, 12**, the separating of the masks **12, 12** being adjustable by means of adjusting screws **21.** The masks **12, 12** each have a central aperture in which an elongated anode **14** is mounted to form an electrolyte containing anode chamber **12***a*, **12***a* between the blade strip **13** and the respective anode **14, 14.** External connection to the anodes is made through four terminals **15** which extend through the wall of the cathode housing **10**, being insulated therefrom by insulators **16.** The masks **12, 12** are also shaped to provide cathode chambers **12***b*, **12***b* whose shape will be described in greater detail hereafter. Four inlet ports **17** for electrolyte are provided towards one end of the cell, two to feed electrolyte under pressure through the two anode chambers **12***a*, **12***a* and the other two to feed electrolyte through the two cathode chambers **12***b*, **12***b*. Four corresponding outlet ports **18** are provided towards the other end of the cell. The final portion of the cell at each end beyond the ports **17, 18** is closed by a manifold of insulating material such as ceramic or plastic, for example polytetrafluoroethylene. Air is fed under pressure to each manifold through a respective air inlet port **19** and through labyrinth seals (not shown) in the manifold to a respective outlet port **20** in order to form an air seal to prevent, or substantially reduce, escape of electrolyte.

The current path is from each anode **14** through the electrolyte in its respective anode chamber **12***a* to the central portion of the blade strip **13**, through the blade strip to the exposed surface at each edge and thence through the electrolyte in the respective cathode chamber **12***b* to the cathode. The novel electrode arrangement is the subject of a co-pending patent application.

With the present invention there is a restriction on the amount of electrolyte in the region at each edge of the blade where the facets of the cutting edge are to be formed, this restriction of the electrolyte facilitating the production of facets of desired surface contour for reasons which will be discussed in greater detail below. One method of achieving this, which is shown in FIG. 3, is by shaping the screening masks **12** so that each cathode chamber is formed with a channel into which projects the edge of the blade strip **13** at which the facets of the cutting edge are to be produced. As illustrated the channels are V-shaped in cross-section but many other shapes may be employed. For example, the channel may be parallel-sided or may be flared with other than a V-shaped cross-section. The angle of inclination of the sides of the channel will be chosen in dependence upon the operating conditions, such as current density and electrolyte, but by way of example, where electroforming is to be performed the cell, or at least the initial section thereof, could typically have an included angle for the channel of 80°, that is to say the surface of each mask being inclined at 40° to the major plane of the blade strip. For electrofinishing of an already partially formed edge the included angle may, for example, by 60° or even as little as 40°. The amount of the edge of the blade strip which projects into the channel is a matter of choice dependent upon the desired extent and form of the facets of the finished razor blade, but for typical double-edged razor blades the amount might be between 0.6 and 1.3 mm. The principal effect of the amount of electrolyte decreasing progressively from the mouth of the channel inwards is that the current flowing to the strip is increasingly limited away from the tip of the strip. The consequence is that because the current is greatest at the tip of the blade and decreases with increasing distance from the tip, there is greater removal of metal from the tip and progressively decreasing removal of metal with increasing distance from the tip. In this way choice of an appropriate cross-section for the channel permits the formation of facets of desired shape appropriate for razor blades. For example, in contrast to the planar facets normal when forming a razor blade cutting edge by abrasive methods the facets may have a convex contour.

It will be understood that the strip may be fed in succession through a number of cells having screening masks providing channels of different cross-section, with the channels in successive cells being progressively narrower as the facets approach more nearly to their final form. Alternatively the contour of the masks in a single cell may change either progressively or in steps with the same object. In the case of electrofinishing, the masking conditions will be less critical the more nearly the edge has been formed to its final shape prior to the electrolytic treatment.

Whilst reference has been made to the use of ceramic material for the masks, other insulating materials may be used such as plastics, in particular polytetrafluoroethylene. On the other hand metal may be used for the masks by insulating the masks from the cathode and using the masks as anodes. In this event the metal employed should be such that it is polarised in the operational condition of the cell so that the masks can provide a conductive connection to that portion of the strip with which they are in physical contact but so that there is negligible conducion between the electrolyte and the exposed surfaces of the masks. Examples of suitable metals of which such masks may be composed are titanium, tungsten, tantalum, niobium or zirconium. Complete polarisation of the material is not essential because effective dissolution of the strip would still be possible even if the masks carried a low proportion of the current.

Although reference has been made to the unidirectional potentials alternating current may be used for the processing.

Masks can also be used where razor blade blanks are processed in stacks by interleaving blade blanks with masks. However, another method of processing blanks in stacks is partly to form a cutting edge on the blanks by mechanical methods, such as by abrasive removal of metal or by pressing, to provide facets such that when the blade blanks are superposed one on the other only the facets are exposed and the channels between each pair of adjacent facets acts to limit the current differentially in the manner described above.

A preferred electrolyte, which is the subject of a co-

pending patent application, has the composition 35 to 65% by weight of phosphoric acid, 5 to 15% by weight of sulfuric acid, 0 to 8% chromium trioxide and the balance water, the bath operating temperature being for example between 55 and 85° C.

The invention is not restricted to the formation of cutting edges on razor blades but is applicable to the formation of other types of cutting edges.

I claim:

1. In an electrolytic cell for at least finishing the cutting edge of a razor blade,

an elongated cathode,

means for electrically connecting said cathode to a negative terminal of a source of current,

at least one anode, and

means for connecting said anode to the positive terminal of said source of current, and

guide means for supporting a razor blade having at least one unfinished cutting edge in predetermined position relative to said cathode and said anode, said guide means and said cathode defining a first elongated space for containing electrolyte in contact with said cathode, said unfinished cutting edge projecting into said electrolyte,

the combination with said guide means of surfaces thereon which in the vicinity of the edge of the razor blade are inclined at between 20 degrees and 40 degrees to the major plane of the blade and said surfaces being substantially planar to form an electrolyte passage which in the vicinity of the blade is of diverging cross-section.

2. A cell according to claim **1** wherein said surfaces are inclined at approximately 30° to the major plane of the blade.

3. A cell according to claim **1** wherein said surfaces abut the blade at a distance of between about 0.025 and 0.050 inch from the tip of the cutting edge.

4. A cell according to claim **1** wherein said surfaces abut the blade at a distance of approximately 0.030 inch from the tip of the cutting edge.

5. A cell according to claim **1** wherein said guide means is of a ceramic material.

6. A cell according to claim **1** wherein said guide means is of a plastics material.

7. A cell according to claim **1** wherein said guide means is of a metal which is at least partially polarised in the operational condition of the cell.

8. A cell according to claim **1** wherein the blade is part of an elongated strip from which a number of blades are produced and the blade is moved through the cell during processing, the divergence in cross-section in the direction of the tip becoming less as the blade progresses through the cell.

References Cited

UNITED STATES PATENTS

2,974,097	3/1961	Ramirez et al.	204—206
3,399,130	8/1968	Lovekin	204—206

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204—142, 143