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RAZOR BLADE AND OTHER CUTTING TOOLS

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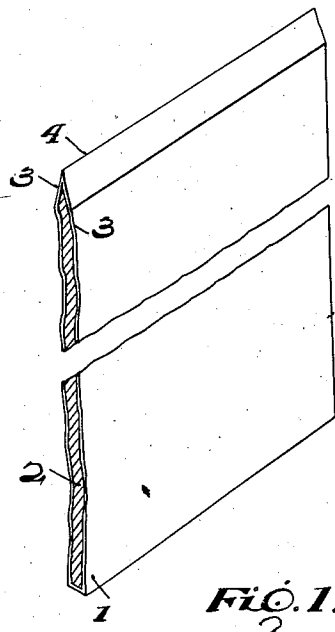


FIG. 1.

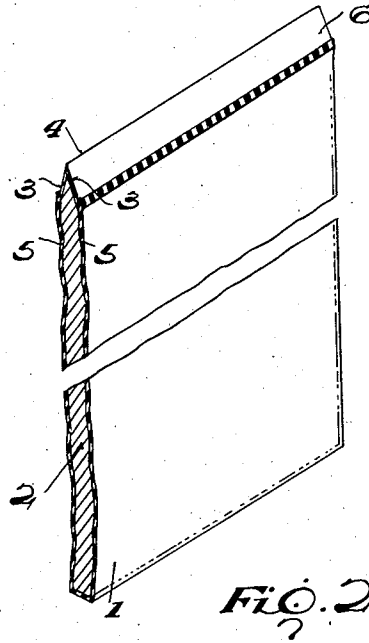


FIG. 2.

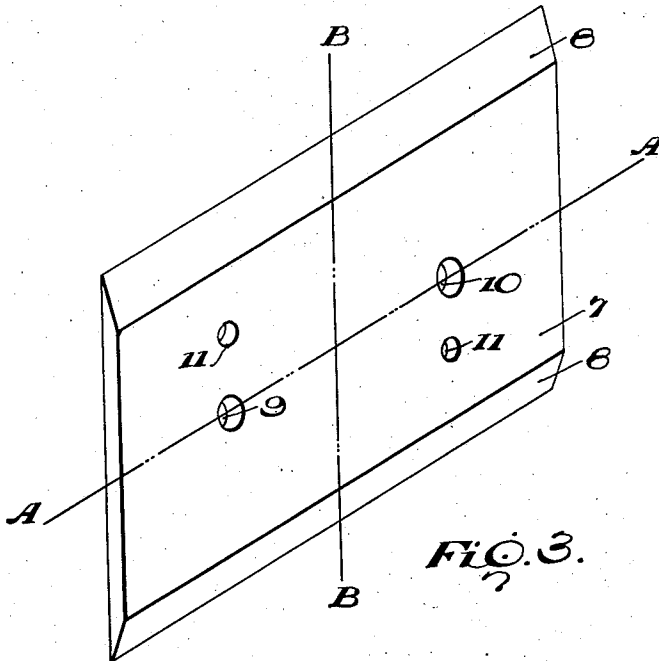


FIG. 3.

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RAZOR BLADE AND OTHER CUTTING TOOLS

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This invention relates to edged tools and more particularly to razor blades adapted for use in safety razors.

An object of my invention is to provide an improved edged tool wherein the cutting edge is of a hardness substantially greater than that of the basic material of the tool and also preferably of the body portion of the tool.

A further object of my invention is to provide a razor blade having at least the cutting edge of a material of greater hardness than obtainable by the use of the steel normally used for razor blades.

A further object of my invention is to provide an improved razor blade made from a non-ferrous metal.

A further object of my invention is to provide a razor blade of aluminum wherein the cutting edge is hardened, preferably being composed of the oxidation product of aluminum.

A further object of my invention is to provide an improved razor blade wherein the cutting edge lies within the plane of one of the major surfaces of the blade.

A further object of my invention is to provide methods by which razor blades having the described characteristics may be made.

With these objects in view, together with such other objects as may appear herein, I declare the following to be a full, clear and complete description of my invention such as will enable anyone reasonably skilled in the cutlery art to practice the same.

Razor blades are conventionally made from steel and are normally made from the type of high-carbon steel used in other cutlery. Occasionally, stainless steel may be used. While razor blade steel is ordinarily heat-treated to increase its hardness, it is usually not brought to the maximum possible hardness, as would be the case if the requirements of the cutting edge were alone taken into consideration, because of demands of simplicity of manufacture or because of the fact that the finished blade must be flexed when used in certain safety razors.

I will described one aspect of my invention as applied to a typical single-edged razor blade and it will be obvious that one skilled in the art will be able to make such adaptations as are required to apply it to other types of blades, such as the familiar double-edged type, sometimes called the "Gillette" type, as well as other tools, without departing from the essence of my invention.

Confining the description, by way of exemplification, to the production of razor blades, in its

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simplest form one aspect of my invention provides a razor blade of aluminum or of an alloy of high aluminum content, both of which will hereinafter be referred to and included within the term "aluminum," having its cutting edge or edges hardened. To this end I preferably cause to be formed, at least where the cutting edge or edges are to be provided, a closely adherent surface layer of the oxidation product of aluminum, taking care that this surface layer, which is of extreme hardness, is applied at such a stage in the making of the blade that the material of the hard surface layer forms the cutting edge or edges of the finally sharpened blade.

In order to bring about the formation of the closely adherent surface layer of the oxidation product of aluminum, of which I have spoken, I subject the blade, partially formed so that the cutting edge and at least the adjacent portion of at least one of the surfaces adjacent the cutting edge will be acted upon, to oxidation by chemical means or preferably by electrolytic means such as anodic oxidation, all according to procedures well-known in the art and described in many reference books on electrochemistry and on metallurgy. I thus produce a blade basically made of aluminum but having at its cutting edge and the adjacent portion of at least one surface adjacent thereto a closely adherent surface layer of oxidized aluminum or aluminum oxide, a substance which in the form thus obtained possesses great hardness and little ductility. The hardness of this layer of aluminum oxidation product far exceeds that of any steel suitable for cutlery. I then finally sharpen the edge of the blade to produce the desired keenness, for which sharpening I find it necessary to use a very hard abrasive material such as finely-ground diamond, boron carbide or silicon carbide. I thus use this extremely hard form of oxidized aluminum to serve as the cutting edge of my blade in the form of a surface layer perhaps no more than 0.001" thick but supported and reinforced by the more ductile, less brittle aluminum backing. In place of the foregoing, however, some of the advantages of my invention may be obtained by providing a blade whose body portion is formed of any suitable metal, such as steel, to which has been securely attached, as by lamination, etc., an edge portion or portions of aluminum to constitute the cutting edge formed as herein explained, or a steel or other suitable metal body may be aluminized in other ways to provide one or more aluminum edge portions for hardening as herein explained.

It will be seen that the mere formation of a

layer of oxidized aluminum on the surface of a wafer of aluminum metal will not necessarily result in a finished blade having its cutting edge composed of the material of the hard layer. It is necessary to combine the steps of forming the hard layer with certain steps of forming the bevelled edge. For example, if I make from suitable thin aluminum sheet a razor blade in the unsharpened condition, which I will call a "blank," produce on its surfaces a layer of aluminum oxidation product by anodic electrolysis, and then grind and hone thereon a suitably doubly-bevelled cutting edge, the finished blade will not be the equivalent of my novel blade because I shall have ground away the hard surface layer where it is required by my invention: namely, at and immediately adjacent the cutting edge. But, by suitably combining the method of producing the hard layer with the steps of grinding and honing the bevelled cutting edge I have produced a novel combination of steps for making a razor blade as well as a novel product.

I will now describe in detail several alternative ways in which I may practice my invention, the descriptions being in terms of a blade material of aluminum and of anodic electrolysis for producing the hard surface layer, it being understood, however, that at least some of the advantages of my invention may be obtained by substituting any suitable non-electrolytic methods for producing the hard surface layer, although not necessarily with equivalent results.

I prefer to use one of the hard alloys of aluminum such as the alloy commonly known as Duralumin (but herein included in the term "aluminum" as above explained), and if a heat treatable material is used it is preferable to have it in its hardened condition. I use the selected metal in the form of a blank of any appropriate dimension, shape and thickness; as for example, a rectangular wafer about one and one-half inches by three-quarters inch and of thickness from less than four one-thousandths of an inch to more than one one-hundredth of an inch, a thickness of about seven one-thousandths of an inch being very suitable. I then form as by grinding a cutting edge on at least one of the margins of this piece, as for example on one of the one and one-half inch margins. I then convert the surface layer of this piece at the cutting edge and the adjacent surface of at least one surface adjacent thereto to the oxidation product of aluminum by making it the anode in a suitable electrolyte, according to techniques well known in that art. I may vary the thickness of the layer of aluminum oxidation product within wide limits by suitable adjustment of the conditions of the electrolysis such as, the time, the current density and the temperature. The thickness of the layer of aluminum oxidation product necessary to attain the object of my invention may be varied within wide limits but, in general, one or two one-thousandths of an inch is sufficient although less may be used and a greater thickness brings no appreciable disadvantages. My blade is then ready for final sharpening, sometimes called "honning," which I carry out in any suitable manner as by holding the blade at the proper angle in contact with the surface of a rotating lapping wheel or moving belt carrying abrasive material such as diamond, boron carbide or silicon carbide. I take care that this final sharpening of my blade is controlled so that the aluminum oxidation product at the cutting edge is not entirely ground away so as to expose the

relatively soft metal underneath; in fact, I prefer to carry the sharpening only so far as is necessary to develop the desired keen edge, particularly if the hardness of the layer of aluminum oxidation product tends to decrease with depth from the outer surface.

I have also found that good results are obtained by applying the final sharpening to only one face of the bevelled edge of the blade. This has the advantage of removing a minimum amount of the hard layer at the cutting edge.

In the drawing, which is diagrammatic only, Fig. 1 is a broken away section of an embodiment of my invention;

Fig. 2 is a like section of another embodiment; and

Fig. 3 is a perspective of a third embodiment.

Referring to Fig. 1 of the drawing, 1 is a single-edged razor blade formed from aluminum 2, the blade being broken away in order to show the relationship of the hard surface layer of aluminum oxidation product 3 to the remainder of the structure. It will be noted that the hard surface layer 3 extends to and actually forms the cutting edge 4 of the blade.

I have pointed out that, to obtain certain of the benefits of my invention, it is necessary to form the layer of great hardness only in the immediate vicinity of the cutting edge in such a way that the cutting edge lies therein. Therefore, it is obvious that I may utilize known methods for preventing the formation of the hard surface layer on areas of the blade where it is not desired or needed, a practice sometimes called "stopping off." This is readily done by applying to those areas to be protected from formation of the layer of aluminum oxidation product an adherent coating of suitable resistant varnish thoroughly dried after application. Such a coating is well known in the art and is sometimes called a "resist," in which sense the term is used herein. For example, I may coat the entire surface of the aluminum blank from which I form my blade with a layer of resist. I then grind or otherwise form a suitable doubly-bevelled cutting edge on one or more margins of the blank. The faces of this bevelled portion are then, of course, free from the protective resist which covers all other areas of the blank. I next produce the hard surface layer of oxidized aluminum as previously described herein and then follow with the final sharpening also as previously described. In this way only the faces of the bevelled portion of the blade are covered with the surface layer of aluminum oxidation product. One of the advantages of this limited application of the hard surface layer is that the finished blade can be flexed in a direction normal to the bevelled edge, as is required in using such blades in certain safety razors, whereas if the hard layer extended over the entire blade surface the hard layer would be likely on flexing to crack, due to its inherent low ductility and great hardness. The result of this method of confining the hard surface layer to the bevelled portion of the blade is illustrated by reference to Fig. 2 of the drawing in which 1 represents a broken away portion of a finished blade of aluminum 2 made from a blank the surfaces of which were coated with a layer of resistant varnish 5. During the formation of the bevelled portion 6 the varnish has been removed thus exposing the aluminum base and permitting the formation of the layer of aluminum oxidation product 3 on the faces of the bevelled portion including the cutting edge 4.

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I may also practice my invention by forming the hard surface layer on but one of the faces of the doubly-bevelled margin, as follows: I coat the blade blank as previously described with a layer of resistant varnish, form as by grinding a singly-bevelled edge on at least one of the margins of the blank thus exposing an area of unprotected metal, then subject the blank to the process for forming the hard layer, next I complete the formation of the cutting edge by grinding or otherwise forming the complementary bevel to the one first formed, and finally sharpen to the desired keenness by honing one or both faces of the bevelled portion.

Or, alternatively, I may doubly bevel one or more margins of the blank, apply the resist over the entire surface thereof, remove as by grinding the resist from one of the faces of the bevelled portion, subject the blank to the specified process for formation of the oxidized aluminum layer and finally hone one or both faces of the bevelled portion until the desired keenness of the cutting edge is attained.

As a further alternative procedure, I may singly bevel the margin of the blank, apply the resist over the entire surface thereof, form the complementary bevel to the one first formed thus exposing unprotected metal, oxidize the metal thus exposed and finally hone one or both faces of the bevelled portion.

The foregoing alternative procedures are to be taken as typical and not exclusive, as various other alternative procedures will now be apparent to those skilled in the art and are within the contemplation of the present invention.

I have stated as one of the objects of my invention the provisions of a razor blade having its cutting edge lying substantially in the plane of one of its major surfaces. Such a blade is a radical departure from the conventional type of blade which is so ground as to form a double bevel whose surfaces each form an obtuse angle with the adjacent major surfaces of the blade. I make this novel blade by so forming the bevelled edge that a single bevel is produced which forms an obtuse angle with one adjacent major surface of the blade and an acute angle with the other major surface. In this type of blade it will be seen that the cutting edge lies substantially in the plane of one of the major surfaces. The first, or conventional, of these two types of blade edges is for convenience of description herein called "doubly-bevelled" and the second is referred to as "singly-bevelled."

The proper functioning of a blade in a safety razor is partially dependent upon the separation between the edge of the blade and the guard. Therefore, it is obvious that a blade of the singly-bevelled type should be so designed with reference to its cooperating razor that the same major surface of the blade will always be presented to the face in shaving. Otherwise there would be a variation in the edge-to-guard distance upon obverse and reverse insertion of the blade in the razor. I have provided for this by equipping my blade of the singly-bevelled type with apertures disposed unsymmetrically with reference to the major central axes of the blade and adapted for cooperation with similarly arranged locating members in the razor in which it is to be used, the arrangement of the apertures being such as to permit of but one orientation of the blade in the razor. This aspect of my invention is illustrated in Fig. 3 of the drawing which shows a

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double-edged razor blade 7 with singly-bevelled edges 8 the blade having apertures 9, 10, 11 unsymmetrically located with reference to the major axes AA and BB of the blade. It will be obvious that such a blade can be inserted in only one orientation with respect to a safety razor having a similarly arranged group of locating members.

The novel blade just described is according to the present invention made from aluminum by methods similar to those I have described herein in connection with the making of my doubly-bevelled aluminum razor blade. I prefer to apply to the surfaces of the blank a coating of resist covering the entire area except opposed marginal strips on both major surfaces, the said uncoated areas being of width approximating that of the bevels subsequently formed as hereinafter next described. I then form as by grinding singly-bevelled cutting edges, each of the single bevels forming an obtuse angle with one and the same major surface of the blade, oxidize the exposed aluminum to form the hard surface layer as previously herein described and finally hone the cutting edges to the desired keenness.

Or, alternatively, I may omit the application of the resist, form the singly-bevelled cutting edges as next previously described, form the hard surface layer over the entire area of the blade and finally hone the cutting edges to the desired keenness.

Both methods for making my singly-bevelled blade next previously described produce a blade which not only has its cutting edge composed of the oxidation product of aluminum but also has a layer of the same material on the face of the adjacent bevel as well as on the adjacent marginal area of the reverse side of the blade.

I find, however, that good results are obtained if I so form the blade that the hard surface layer of oxidized aluminum includes only the cutting edge and an adjacent area which may be either the angular face of the bevel or an adjacent marginal area of the opposite face of the blade.

For example, I may apply the oxidizing treatment to the entire surface of the aluminum blank, form as by grinding the singly-bevelled cutting edges as previously herein described and finally hone these edges to the desired keenness.

Or, alternatively, I may apply resist to the surfaces of the blank, form thereon the singly-bevelled edges as described, apply the oxidizing treatment to the metal exposed at one side of the blank and finally hone the cutting edges to the desired keenness.

Other procedures for making the singly-bevelled blank will also be apparent to those skilled in the art. While I have described this embodiment as shown in Fig. 3 as having two cutting edges, it is apparent that this blade may have only one cutting edge analogously as the embodiments shown in Figs. 1 and 2 may have a plurality of cutting edges by applying the foregoing or any other suitable procedures to opposed edges of the blank.

While I have hereinbefore assumed an aluminum blank in explaining the invention, it is to be expressly understood that the blank may be provided with a body or core of any other suitable metal that has aluminum appropriately attached thereto where the cutting edge of oxidized aluminum is to be produced in conformity with the present invention. Thus steel can be laminated with aluminum in a number of ways known to the art, and if preferred

such laminated metal may be used in forming the blank, or the blank may be formed of steel for example and then coated with aluminum in any suitable way before or after bevelling, etc.

What is claimed is:

1. A razor blade having a cutting edge of oxidized aluminum.
2. A razor blade basically composed of aluminum and having a cutting edge harder than the body of the blade.
3. A razor blade basically composed of aluminum and having a cutting edge formed of the oxidation product of aluminum.
4. A razor blade basically composed of aluminum and having a cutting edge of a compound of aluminum and oxygen harder than the body of the blade.
5. The method of making a cutting tool which includes the steps of forming a blank having at least one edge basically composed of aluminum, forming a bevel along at least one side of the blank at said edge, rendering the edge of the bevel and at least the surface adjacent thereto on at least one face harder than the body material of the blank by oxidizing the said edge and said surface, and then sharpening the hardened edge.
6. The method of making a razor blade which includes the steps of forming a blank of aluminum, forming a bevel along at least one side of the blank, oxidizing the aluminum at the edge of the bevel and at least the surface adjacent the edge on at least one face, and bringing the oxidized edge to a cutting edge.
7. The method of making a razor blade which includes the steps of forming a blank of aluminum, forming a bevel along at least one side of the blank, anodizing the aluminum at the edge of the bevel and at least the surface adjacent the edge on at least one face, and bringing the anodizing edge to a cutting edge.
8. The method of making a cutting tool which includes the steps of forming a blank of aluminum, forming a double bevel along at least one

side of the blank, oxidizing the edge of the bevel and at least one of the sides of the bevel, and sharpening the oxidized edge.

9. The method of making a cutting tool which includes the steps of forming a blank of aluminum, forming along at least one side of the blank a bevelled surface by bevelling only one face of the blank to substantially a cutting edge, hardening said edge and at least the surface adjacent the edge on at least one side by oxidizing the said edge and said surface, and sharpening the hardened edge.
10. A razor blade having opposed cutting edges formed by converging surfaces one of which for each edge is the same major surface of the blade, the other surface of each edge being inclined to the said major surface of the blade, and means provided on said blade for cooperation with means on a guard to require the same face of the blade to be disposed adjacent the guard whichever edge is in operative position.
11. An aluminum razor blade having at least one cutting edge formed by converging surfaces one of which is a major surface of the blade and the other of which is inclined to said major surface of the blade, said cutting edge being formed of an oxidation product of aluminum.
12. A severing cutting tool having a linear cutting edge of oxidized aluminum.
13. An aluminum cutting tool having a cutting edge formed of converging surfaces one of which is a major surface of the tool and the other of which is a surface bevelled at only one face of the tool, said edge being formed of oxidized aluminum.
14. A razor blade having a bevelled portion along at least one of its margins, at least said bevelled portion having at least one surface formed of an adherent layer of the oxidation product of aluminum, the cutting edge of the blade being composed of the said oxidation product of aluminum.

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