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POLYTETRAFLUOROETHYLENE COATED RAZOR BLADE

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5 Claims. (Cl. 30—346.53)

This application is a division of our application Ser. No. 286,490, filed June 10, 1963 and now U.S. Patent 3,345,202.

This invention relates to improvements in razor blades whereby the shaving qualities of the blade are greatly enhanced and the useful life of the blade materially increased. The invention provides improved razor blades, embodying the improvements just described, and also provides a method whereby the improved blades may be readily, economically and consistently produced.

The razor blades of this invention are composed generally of a ferrous alloy base metal, i.e., either carbon steel, stainless steel or other chromium containing alloy, and have at least one cutting edge which has been preformed and treated as hereinafter described.

For improving the shaving properties of razor blades, it has heretofore been proposed to apply to the blade, at least in the vicinity of its cutting edge or edges, a thin adhering coating or film of a lubricant or abhesive material for reducing friction between the cutting instrument and the face and beard of the shaver and thereby providing a better, more comfortable shave. For instance, a solid polymer of tetrafluoroethylene, such as commercially known "Teflon" (a registered trade-mark), has previously been proposed as a lubricant or abhesive material to be used for this purpose.

In accordance with such proposals, the solid fluorocarbon polymer is applied to the presharpened and prehoned blade, at least to the cutting edge thereof, as a suspension or dispersion in a volatile liquid medium, e.g., water or an organic solvent, as by dipping the edges of the blade into the suspension or by brushing or spraying the suspension onto the blade. The coating thus deposited on the blade is thereafter dried by evaporating the liquid medium and the blade then baked at an elevated temperature to sinter or fuse the solid fluorocarbon particles and form an adherent thin coating. It has been suggested, for instance, that the baking operation be carried on at temperatures ranging from about 200° F. to about 750° F. in an oxidizing or neutral atmosphere.

As described in copending application Ser. No. 226,169, filed Sept. 25, 1962, now U.S. Patent No. 3,203,829, it has been found that far superior and much more consistently improved results are obtained where the baking or sintering of the dried fluorocarbon coating is carried out in a reducing atmosphere, such as an atmosphere which is predominantly hydrogen or an atmosphere consisting essentially of hydrogen and nitrogen, advantageously the thermal decomposition products of ammonia. By the procedure therein described and claimed, excellent results have been obtained, whether the base metal is carbon steel or stainless steel, and a superior razor blade has resulted.

However, in the testing and general use of the resultant razor blades, it has been observed that those superior shaving results are frequently not obtained on the first few strokes of a new razor blade. The maximum benefit from the superior nature of the blade is usually not obtained until the first shaving operation has progressed

to about one-fourth or one-half completion. Thereafter, maximum benefit is obtained for repeated shaves. The reason for this break-in period is not fully understood.

It is an object of the present invention to avoid the break-in period, just referred to, and to provide a razor blade which exhibits superior shaving properties and comfort from the first stroke of the first shave and throughout repeated shaves.

In accordance with our present invention, this object is attained by applying to a pre-ground and honed cutting edge of a razor blade, of any of the base metals heretofore described, a thin plating of chromium of a thickness of the order of a fraction of a micron, rehoning the plated cutting edge and applying an adherent coating of the polytetrafluoroethylene to the rehoned, plated edge, after thoroughly cleaning the edge.

The applying of the chromium plating to the blade may be effected by any known procedure adapted to give a smooth uniform coating of chromium. The chromium plating may be applied to the cutting edges only or may be applied over the entire blade. We have obtained especially satisfactory results of applying chromium plating over the entire blade, one side at a time, by the well known vapor deposition method. However, the invention contemplates the use of other known methods for applying the chromium plate, e.g., electroplated hard chromium coating procedures.

As has heretofore been recognized, it is essential that the blade be thoroughly cleaned, before attempting to apply the chromium plating thereon, to remove any oil or other foreign substance therefrom including absorbed films. Cleaning by means of a glow discharge has been found highly satisfactory especially where the chromium is to be applied by the vapor deposition method herein described in detail.

Following the chromium plating, the blade is stropped lightly on leather adequately to restore the blade to its desired sharpness without wearing through the chromium plating to expose the base metal.

After the resharpening operation, the blade is again thoroughly cleaned, as by spraying with trichloroethylene, dried in air, coated with the polytetrafluoroethylene dispersion, again dried, and baked to form a strongly adherent coating of the polytetrafluoroethylene, advantageously in a reducing atmosphere, as previously described herein.

In the following specific examples, we describe in detail our presently preferred method of producing these superior razor blades. It will be understood, however, that the invention is not restricted to the detailed operations of these examples, but includes various modifications which, in view of the present disclosure, would occur to one skilled in this art and which are encompassed by the accompanying claims.

As previously noted, the base metal of the razor blade may be carbon steel, for instance 1.25% carbon, or stainless steel of 1.0% carbon and 14% chromium, or various other ferro-chromium alloys. Prior to applying the chromium plating, the blades will be sharpened, as by standard commercial procedure, to conventional cutting edge angles and widths of facets.

The sharpened blades are, with advantage, initially cleaned by spraying with trichloroethylene and the blades then placed in a vacuum chamber wherein the pressure is reduced to about 10 to 100 microns of mercury and wherein the blades are further treated and cleaned by means of glow discharge.

This glow discharge is, with advantage, produced by electric current of 150–200 ma. under an applied voltage between the blades and an electrode, spaced 12 inches apart, of 1000 to 1500 volts at the 100-micron pressure and up to 3000 volts at the 10-micron pressure.

This glow discharge is permitted to proceed for several minutes, advantageously about 3 minutes, and is then discontinued. Thereafter, the pressure within the chamber containing the blades is reduced to 10^{-4} millimeters of mercury and a pellet of chromium, about 250 milligrams, is placed in a tungsten boat, positioned about 12 inches below the blades, and electrically heated to the vaporizing temperature of the chromium, for instance by the passing of 10 amperes of electricity at about 40 volts through the tungsten boat. By this procedure, the chromium plating is applied to one side only of the razor blades. The blades are then turned over and the operation repeated.

In this manner, there is formed on both sides of the cutting edge of the razor blade, a strongly adhering, extremely thin plating of chromium of insufficient thickness to materially change the angles and facets of the presharpened blade. However, a final stropping is usually required. This may, with advantage, be effected by stropping on leather with light pressure, for instance 10–20 strokes of 3 inches each per side or until the desired sharpness is obtained.

The rehoned blades should be recleaned thoroughly, as by spraying with trichloroethylene, and dried in air. A dispersion of polytetrafluoroethylene, e.g., Teflon, is then applied to the cutting edges of the blades, advantageously an aqueous dispersion, and the dispersion is then dried and baked as previously described herein.

Advantageously, the baking operation is performed by placing a rack of the coated razor blades in a sealed retort under an atmosphere of cracked ammonia and raising the temperature of the retort and contents to about 720° F. over a period of about 10 minutes. Thereafter, the retort is removed from the heating furnace and permitted to cool in air to below 300° F. before any oxidizing gas is permitted to come in contact with the blades. With advantage, the blades are rapidly cooled from the maximum baking temperature by spraying the retort with water, for instance cooled to a temperature of about 620° F., and thereafter cooled further as just described.

Special precaution should be taken to assure good, uniform adherence of the polytetrafluoroethylene coating to the chromium plate and to obtain a uniform coating of the aqueous polytetrafluoroethylene dispersion on the chromium plate. In these respects, the forming of the polyeterafluoroethylene coating on chromium is more difficult than where the coating is formed directly on carbon steel or stainless steel.

We have found that uniformity of the polytetrafluoroethylene coating and adherence of the coating to the chromium base are markedly promoted by including in the polytetrafluoroethylene dispersion applied to the blade a wetting agent in a proportion in excess of that normally used for stabilizing such dispersions. For this purpose, we have, with particular advantage, used a wetting agent marketed under the trade name Triton X–100 consisting essentially of a non-ionic octylphenoxyethanol, sometimes designated polyethylene glycol mono-p-octylphenyl ether.

This wetting agent has been frequently used in aqueous dispersions of polytetrafluoroethylene, e.g., Teflon, in proportions adequate to stabilize the dispersion. However, for purposes of our present invention, it is recommended that the proportion of wetting agent be substantially in excess of that normally present in commercial Teflon dispersions.

In place of Triton X–100, one may use, with advantage, other non-ionic wetting agents which are substantially completely vaporized at the baking temperature employed, say at temperatures in excess of about 600° F.

The proportion of wetting agent to be used in accordance with our present invention is subject to considerable variation dependent upon the particular wetting agent used, the method of applying the coating to the razor blade and other operating details. It is, therefore, impractical to prescribe a proportion or range of proportions most advantageous under all operating procedures. The proportion used, as previously noted, should be substantially in excess of that required merely to stabilize the dispersion. Following this criterion, the optimum excess is readily determinable by simple tests.

Excellent results have been obtained using as the coating composition an aqueous dispersion produced by diluting one part of an aqueous dispersion of polytetrafluoroethylene marketed by Imperial Chemical Industries under its proprietary name Fluon GP–1 with 9 parts, by weight, of a solution of 0.25% Triton X–100 wetting agent in distilled water.

By conventional test methods, involving a special shaving panel, the blades produced, as herein described, by applying a thin chromium plate to a stainless steel base and applying a polytetrafluoroethylene coating over the chromium, have been rated superior to the blades produced by applying the same polytetrafluoroethylene coating to a stainless steel edge. Likewise, the blade resulting from applying the chromium plate to a carbon steel base and thereafter coating the cutting edge with polytetrafluoroethylene, as herein described, was found superior to that where the polyetetrafluoroethylene coating was applied directly to the carbon steel base.

We claim:

1. A razor blade composed of a ferrous alloy base metal and having at least one cutting edge which is chromium-plated and the chromium plate coated with a thin adhering coating of polytetrafluoroethylene.

2. The razor blade of claim 1 in which the base metal is carbon steel.

3. The razor blade of claim 1 in which the base metal is a ferro-chromium alloy.

4. The razor blade of claim 1 in which the base metal is stainless steel.

5. The razor blade of claim 1, the chromium plating having been applied to a preground and prehoned cutting edge thereof and the cutting edge rehoned following application of the chromium plate prior to the application of the polytetrafluoroethylene coating.

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