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RAZOR BLADES

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This invention relates to improvements in razor blades whereby the shaving qualities of the blade are greatly enhanced. It relates more particularly to razor blades of steel, i.e., either carbon steel or stainless steel, to which there has been applied, at least in the vicinity of the cutting edge thereof, a thin adhering coating or film of a lubricant or abhesive material whereby the shaving properties of the blade are improved by reducing friction between the cutting instrument and the face and beard of the shaver.

For this purpose, it has heretofore been proposed to apply to the razor blades an adhering, thin coating or film of a fluorocarbon, more particularly a solid polymer of tetrafluoroethylene, such as commercially known as "Teflon" (a registered trademark).

In accordance with such proposals, the solid fluorocarbon polymer is applied to the blade 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 blades; the coating thus deposited then being dried by evaporating the liquid medium and the blades baked at an elevated temperature to fuse the solid fluorocarbon particles and form an adhering thin film.

In accordance with these prior proposals, the baking operation is carried on at temperatures ranging from about 200° F to about 750° F. in an oxidizing or neutral atmosphere. Such proposals have been disclosed, for instance, in French Patents 1,299,519 and 1,293,388.

It is well-known that "Teflon," for instance, is an excellent abhesive material. In other words, it has a strongly developed tendency to adhere to nothing and to prevent other things from adhering to it, a property commonly known as "release" or "abhesiveness." Consequently, much attention has been given to ways and means of causing such fluorocarbons to bond with a metal surface to form a strongly-adhering thin film thereon. Though baking, as decribed above, has been resorted to for accomplishing this purpose, numerous difficulties have been encountered in its practical application for the production of uniformly superior razor blades at commercial production rates.

One of the difficulties encountered has been the problem of corrosion of the blade during the high temperature baking operation. Another is an apparent erratic interference with uniform bonding of the coating to the blade. Such difficulties have resulted in relatively low production yields of nonuniform quality.

The problem is lessened to some extent by carrying out the baking step in an inert atmosphere, such as argon or nitrogen, instead of air. But even where this precaution is taken, the quality obtained and the yield of acceptable treated blades have been found insufficient to make the process usable by a commercial producer of razor blades without incurring excessive production and quality control costs.

The present invention is predicated on our discovery that the objections and difficulties heretofore encountered in treating razor blades in accordance with the disclosures of the previously noted French patents may be overcome and a high yield of fluorocarbon-coated razor blades of improved and highly uniform quality obtained by carrying out the baking, bonding or sintering phase in a reducing atmosphere, such as an atmosphere which is predominantly hydrogen, and that especially advantageous results may be obtained where the reducing atmosphere is composed primarily of hydrogen and nitrogen, advantageously a reducing atmosphere such as results from the thermal dissociation of ammonia consisting primarily of hydrogen and nitrogen and containing a minor proportion of undecomposed ammonia.

Predicated thereon, the invention, in its broader aspect, is applicable to the bonding of thin films of various fluorocarbons to razor blades of either carbon steel or stainless steel, for instance, fluorocarbons such as polytetrafluoroethylene, i.e., "Teflon," or polytrifluorochloroethylene, fluoronated ethylenepropylene or the like. However, it has been used, with particlar advantage, in applying to razor blades thin adhering coatings of "Teflon." It is applicable to various baking conditions of time and temperature, as noted, for instance, in the aforesaid French patents, optimum time and temperature conditions being interdependent.

More specifically, the baking temperature may range from 300° F., or somewhat lower, to about 750° F., due consideration being given to danger of deleteriously affecting razor blade steel by extended periods of high temperature, as well understood in the art.

In accordance with this invention, the fluorocarbon is applied to the razor blade, as by dipping, coating or spraying, as a suspension or dispersion thereof in a volatile liquid medium and the applied coating should be well dried by evaporation of the liquid medium prior to subjecting the blade to the baking step, so as to avoid contaminating the reducing atmosphere. As the liquid medium, one may use water or an organic solvent, as has been previously proposed.

Generally, the razor blades will have been carefully sharpened and cleaned prior to the application of the coating thereto and we have found that one of the primary problems involved is the retention of the sharpness of the edges during the treatment. In this respect, the sharpened razor blades may be deleteriously affected by even a minute amount of oxidation during the baking operation. Damage to the razor blades due to such oxidation is entirely avoided where the baking step is carried on in a reducing atmosphere, in accordance with this invention. Further, in accordance herewith, a stronger, more uniform and more lasting adhesion of the coatings to the blade is obtained and the blades so produced have been found to have more uniformly superior shaving quality than those heretofore available.

While we do not intend to be bound by any theory as to the reason or reasons for the superior properties of our blades, it presently appears that the reducing atmosphere maintained during the baking operation tends to reduce and remove any oxide film present on the facets or bevels forming the cutting edge which, in turn, promotes tighter and more uniform bonding of the fluorocarbon to those surfaces, as well as entirely inhibiting any corrosion, etching or oxidizing of those surfaces. Further, the reducing atmosphere tends to remove the effects of any oils or other organic matter retained on those surfaces, thus further assuring a tighter bonding of the film to the steel without any contaminating influences of such oils or other organic materials. Thus, a more durable film of the lubricating material on the blade edges is obtained.

Also, where a reducing atmosphere of hydrogen and nitrogen is used in the baking step, especially at baking temperatures around 600–700° F., it appears that a hard thin layer of nitrided steel is formed on the facets and bevels forming the cutting edges of the blade, which is

abrasion resistant and imparts additional durability to the blade.

Though corrosion, etching and oxidation of the cutting edges may be materially reduced when the coated blades are baked in a neutral atmosphere, as might be expected, we obtain, in accordance with our present invention, blades of even more greatly improved shaving properties than those obtained where the baking step is carried on in a neutral atmosphere and, therefore, the superiority of our present process, and the razor blades so treated, is not entirely attributable to the avoidance of oxidation.

Our invention, and one practical application thereof, will be illustrated by the following description of a presently preferred commercial operation. It is understood, however, that the invention is not restricted to this particular embodiment and that many modifications thereof are contemplated within its scope.

In this particular embodiment of the invention, the ground and sharpened safety razor blades are first assembled in quantities of approximately 1000 to 2000 in a bayonet-type fixture or holder and the blades cleaned, for instance by washing in cold trichloroethylene, and are then rinsed and dried. The dried blades are then preheated to a temperature of 160° F. to 180° F. and sprayed with a dilute dispersion of polytetrafluoroethylene, for instance, an aqueous dispersion known commercially as "GP 1" or that known as "Teflon 30." Advantageously, the concentration of the dispersion may be about 1 part, by weight, of the polymer to 9 parts of water. The coating thus applied to the edges of the blades should be thin and uniform.

The blades with the coating thereon are then heated to a temperature of about 635–660° F. in an atmosphere of dissociated ammonia, the atmosphere being supplied to the treating chamber at a rate equivalent to about 5 cubic feet of hydrogen (S.T.P.) per hour per 1000 blades. This heating cycle is continued for 20 to 30 minutes and thereafter the blades are held at a temperature in excess of 630° F., for instance 650° F., for from 5 to 8 minutes. The blades are then cooled to about 500° F. while still under reducing atmosphere and are then cooled to about 300° F. In order to increase the cooling rate from 500° to 300° F., an inert atmosphere, e.g., nitrogen, may be used. After the temperature of the blades has been reduced to about 300° F., further cooling may be effected by compressed air.

We claim:

1. In the process for treating razor blades whereby a coating of polytetrafluoroethylene, polytrifluorochloroethylene, or fluoronated ethylenepropylene is applied to the cutting edge of the blade surface and the blade with said coating thereon is heated to cause the polytetrafluoroethylene, polytrifluorochloroethylene, or fluoronated ethylenepropylene to form an adhering film on said cutting edge of the blade, the improvement comprising maintaining the blades in a reducing atmosphere during the baking operation.

2. The process of claim 1 in which the reducing atmosphere consists essentially of hydrogen and nitrogen.

3. The process of claim 2 in which the reducing atmosphere is the thermal decomposition products of ammonia.

4. The process of claim 1 in which the coating comprises a solid polymer of tetrafluoroethylene.

5. The process of claim 1 in which the baking operation is effected at a temperature within the range from about 300° F. to about 750° F.

6. The process of claim 1 in which the reducing atmosphere consists of the decomposition products of ammonia and the baking operation is effected at a temperature of about 635–660° F.

7. The process of claim 6 in which the blades are cooled, following the baking operation, to a temperature of about 500° F. while being maintained in a reducing atmosphere and are thereafter cooled to about 300° F. in a nonoxidizing atmosphere.

8. In the process for treating razor blades whereby a coating of polytrifluorochloroethylene is applied to the cutting edge of the blade surface and the blade with said coating thereon is heated to cause the polytrifluorochloroethylene to form an adhering film on said cutting edge of the blade, the improvement comprising maintaining the blades in a reducing atmosphere during the baking operation.

References Cited by the Examiner

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2,880,109	3/59	Current.

FOREIGN PATENTS

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