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RAZOR BLADES

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ABSTRACT OF THE DISCLOSURE

Improved carbon steel razor blades are provided by passing carbon steel strip through a hardening furnace followed by quenching and hardening so that the strip has a retained austenite content in excess of 23%. The blade strip is then sharpened and a fluorocarbon coating is sintered to the sharpened edge.

This invention relates to safety razor blades, either single edged or double edged, and more specifically to a method for processing steel strip to provide a razor blade structure capable of receiving a shave facilitating coating and that has improved shaving effectiveness and blade life, and to improved carbon steel razor blades manufactured in accordance with such method.

The processing of steel strip stock into razor blades conventionally includes the steps of heating the strip stock in a hardening furnace, abruptly quenching the heated steel strip and then tempering the strip to increase its toughness by an age hardening process. One or both edges of the strip are then sharpened to the desired edge configuration. In general, that configuration is a wedge shape, the included solid angle of which is about 25°. The faces or sides of such cutting edges may extend back from the ultimate edge a distance of up to as much as 0.1 inch or even more. Each face need not be a single uninterrupted continuous surface or "facet," but may consist of two or more "facets" formed by successive grinding or honing operations and intersecting each other along zones generally parallel to the ultimate edge. The final facet, i.e. the facet immediately adjacent the ultimate edge, has a width as little as 7.5 microns or even less as compared to the diameter of beard hair which averages about 100 to 125 microns.

It is often preferred to apply to the sharpened edge of the razor blade a thin adherent coating which improves the shaving effectiveness of the razor blade and a preffered form of this coating is a fluorocarbon polymer which functions not only to improve the effectiveness of the first and succeeding shaves, but also to extend the shaving life of the blade. The application of such materials to the cutting edges involves heating the coated edge at an elevated temperature and carbon steel blades of conventional commercial configuration when subjected to such treatment have exhibited less improvement in shaving effectiveness than the maximum which might be expected to be obtained by the coating. For this reason the principal use of such coatings has been on stainless steel blades.

It is an object of this invention to provide a novel and improved method of processing carbon steel razor blades to provide a razor blade of increased shaving effectiveness and life.

Another object of the invention is to provide a method of increasing the included angle of the sharpened edge of a razor blade without modifying the sharpening equipment.

Still another object of the invention is to provide an improved carbon steel razor blade.

In accordance with the invention carbon steel strip stock of commercial razor blade quality is treated in a hardening and tempering sequence. The composition of this steel is a preferred form has a carbon content in the range of 1.15–1.30%; a silicon content in the range of 0.15–0.30%; a manganese content in the range 0.25–0.50%; a chromium content in the range 0.21–0.35%; with sulfur and phosphorus content each less than 0.045%. The balance of the steel is substantially iron with trace amounts of other elements. Such steel in strip form of a thickness of 0.0039 inch and a width of 0.880 inch is processed through a hardening, quenching and tempering sequence at a strip velocity of 65 feet per minute. A hardening furnace about fourteen feet in length is employed and the temperature in that furnace is maintained at at least 1650° F. and preferably approximately 150° F. higher than normal (in the order of 1710° F.). That furnace temperature is controlled to significantly increase the amount of retained austenite in the tempered strip. The percent of retained austenite in the tempered strip should be at least 23% and preferably is at least 25% and in the range of 25–28%.

After passing through the hardening furnace, the steel strip is quenched by passage through quench blocks which are cooled by water at a temperature of 90° F. The strip is then further processed by passage through a tempering furnace three feet in length which is maintained at a temperature of 900° F.

A coat of lacquer is then applied to the hardened strip and that coat of lacquer is cured in conventional manner.

One or both of the edges of the strip are then sharpened with sharpening equipment using conventional sharpening techniques. Such equipment is adjusted to produce, on conventionally processed carbon steel blade strip, an included angle at the final facet (immediately adjacent the ultimate edge) of 25°. However, because of the higher retained austenite content of blades processed in accordance with this invention, the included angle actually produced in such steel is approximately 28°, about 3° larger than that produced in conventional steel blades by this equipment.

A fluorocarbon polymer coating is then applied to the cutting edges of the blade stock, preferably in accordance with the teaching in the copending patent application Ser. No. 384,805, filed July 23, 1964, in the name of Irwin W. Fischbein and assigned to the same assignee as this patent application. This processing involves heating the blade to a temperature preferably in the range of 590°–806° F. and provides on the cutting edge of the razor blade an adherent coating of solid fluorocarbon polymer.

The heating conditions, i.e. maximum temperature, length of time, etc., obviously must be adjusted so as to avoid substantial decomposition of the polymer and/or excessive tempering of the metal of the cutting edge. In a preferred process, the polymer, in the form of dispersion of finely divided particles in an inert volatile liquid, is applied by spraying in a 40 kv. electrostatic field to the sharpened cutting edges of the blade stock. The coated blades, which dry almost immediately due to the evaporation of the inert liquid, are then heated to a temperature from 590°–806° F. for 2 to 15 minutes, e.g. to 650° F. for ten minutes in an atmosphere of hydrogen gas, after which the hydrogen is displaced by nitrogen while cooling the blades to 350° F. The blades are finally cooled in air from 350° F. to room temperature.

This last heating step is employed for the required curing of the coating, but it has a modifying effect on the metallurgy of of the underlying blade. By the practice of this invention an improved combination of retained austenite, included solid angle, and solid fluorocarbon coating is achieved. The increase in included solid angle would ordinarily be expected to result in a blade that has impaired shaving characteristics, but the present combination actually provides a blade that has improved shaving characteristics.

Carbon steel razor blades processed in this manner have shaving characteristics that are significantly superior to the highest quality commercial carbon steel blades heretofore available and also have a shaving life that is greater than that of such high quality carbon steel blades heretofore commercially available.

While a particular embodiment of the invention has been described herein, it is not intended to limit the invention solely thereto, but to include all the variations and modifications which suggest themselves to persons skilled in the art.

What is claimed is:

1. In the process of manufacturing a carbon steel razor blade having a carbon content in the range of 1.15–1.30 percent, the steps of

treating said strip of carbon steel by heating said strip in a hardening furnace maintained at a temperature in excess of 1650° F. for about fifteen seconds, promptly quenching said strip after hardening to a temperature of about 90° F. and then tempering said strip to produce a retained austenite content in excess of 23%, and

sharpening the edge of said strip to form a cutting edge.

2. The process as claimed in claim **1** wherein the austenite content in said steel strip is in excess of 25%.

3. The process as claimed in claim **1** and further including the steps of depositing on said cutting edge a composition comprising a solid fluorocarbon polymer and heating the blade edge with the composition thereon to 590°–806° F. for 2 to 15 minutes in a hydrogen atmosphere to form a coating adherent to said edge.

4. A razor blade manufactured in accordance with the method of claim **1** in which the included angle of the final facet of the cutting edge is at least approximately 25° F.

5. The method of increasing the included angle of a

carbon steel razor blade in a sharpening process comprising the step of treating a strip of carbon steel by heating said strip in a hardening furnace maintained at a temperature in excess of 1650° F. for about fifteen seconds, promptly quenching said strip after hardening to a temperature of about 90° F. and then tempering said strip to produce a retained austenite content in excess of 23% in the steel blade stock to be sharpened.

6. A process of manufacturing razor blades comprising the steps of treating a carbon steel strip by heating said strip in a hardening furnace maintained at a temperature in excess of 1650° F. and then promptly quenching and heat treating said strip after hardening to produce a retained austenite content in the steel in excess of 23%, sharpening an edge of the strip, depositing on the sharpened edge of the strip a composition comprising a solid fluorocarbon polymer, and heating said edge with the deposit thereon to form a coating adherent to the edge.

7. A process according to claim **6** wherein said hardening step is performed by disposing said strip in a heating furnace maintained at said temperature in the order of 1710° F.

8. A process according to claim **7** wherein said strip with the deposit thereon is heated to 590°–806° F. in a hydrogen atmosphere to form said adherent coating.

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