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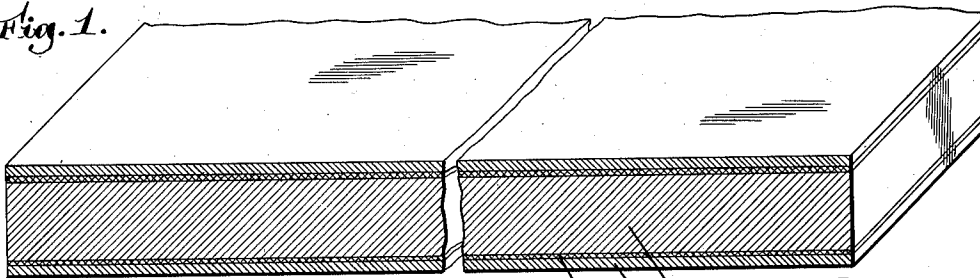
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2,087,051

FINE EDGE BLADE AND METHOD OF MAKING THE SAME

Filed Dec. 21, 1933

Fig. 1.



FERROUS BODY
COPPER SHEATH
ALLOYED BOND

Fig. 2.

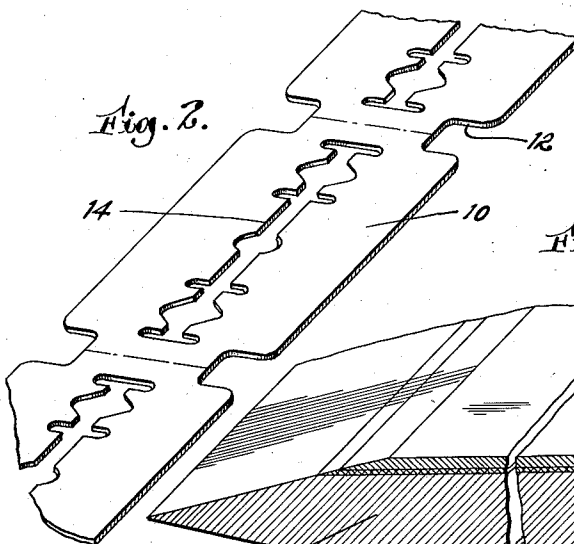


Fig. 3.

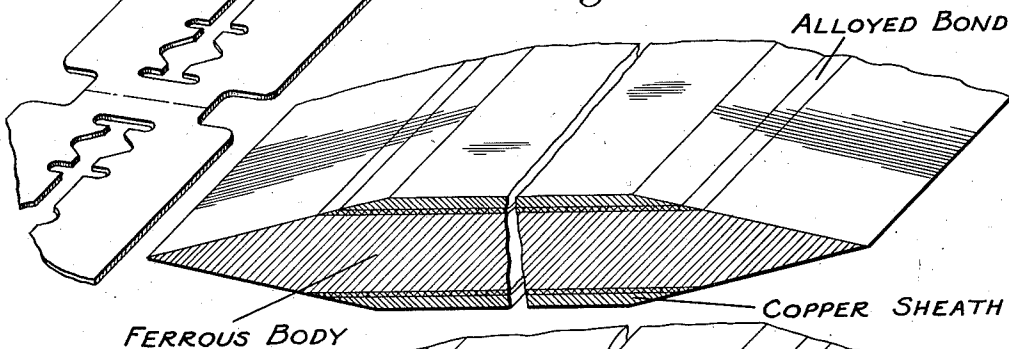


Fig. 4.

FERROUS BODY
ALLOYED BOND
COPPER SHEATH

ALLOYED BOND

HARDENED AND
TEMPERED FERROUS BODY

COPPER SHEATH

NITRIDED FERROUS
EDGE

HONED

NITRIDED FERROUS EDGE

Fig. 5.

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UNITED STATES PATENT OFFICE

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FINE EDGE BLADE AND METHOD OF MAKING THE SAME

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Application December 21, 1933, Serial No. 703,450

11 Claims. (Cl. 148—16)

This invention relates to the manufacture of fine edged flexible blades and blade strips from ferrous alloys which may be hardened by a process of nitriding, that is to say, by introducing nitrogen into or causing it to be combined with the alloy. In one aspect my invention consists in a new and improved method of producing blades from such material. In another aspect it comprises a novel blade or blade strip characterized by a nitrided area in which the cutting edge is included and a hardened and tempered but unnitrided body portion adjacent thereto.

An important field of use of my invention is in the production of safety razor blades of the thin, flexible type which are adapted for use in holders wherein they are clamped for support. For purposes of illustration my invention will be described in its application to that field, although it is not limited in its scope to any specific type of blade or cutting implement.

It will be understood that ferrous alloys capable of being hardened by nitriding and so treated are characterized by extreme hardness. For example, nitralloy blade stock may be hardened by nitriding to a Vickers hardness number well above 900. A blade hardened uniformly to this degree by nitriding would be impractical because of excessive brittleness and in the blades of my invention the nitrided area is accordingly restricted to the cutting edge of the blade and the material in immediate juxtaposition thereto. An important feature of my invention consists in increasing the hardness of the unnitrided portion of such a blade by heat-treatment, whereby abrupt change in the degree of hardness between the nitrided cutting edge of the blade and unnitrided body portion is substantially reduced. If the body portion of a nitridable ferrous blade remains untreated after its edge has been nitrided, there is such an extreme difference in the hardness characteristics of these portions of the blade that an objectionable tendency to warp and twist may develop and it is difficult or impossible to secure a uniformly symmetrical or flat product. Moreover, the body portion of the blade under these conditions remains so flexible that it may become permanently bent or distorted in handling. I have discovered that both of these objections may be eliminated without objectionably impairing the hardness of the nitrided cutting edge of the blade, by the step of hardening and tempering the body portion thereof by heat-treatment. Accordingly, in one aspect my invention comprises a method of producing blades with nitride-hardened edges characterized by the step of heat-treating the

body of the blade to harden and temper it, thus reducing internal stresses and providing blades of resilient character.

An important feature of my invention consists in protecting the body portion of the blade from being nitrided by enveloping it in a non-ferrous sheath, for example, a copper sheath united to the ferrous body of the blade by an intermediate layer of copper and steel interalloyed or mechanically intermingled. Such a sheath is valuable in this connection for several reasons. In the first place, it protects the unnitrided body of the blade against rusting. The nitrided cutting edge of the blade is substantially protected against rusting by the nitriding operation but in blades where any portion of the body of the blade is exposed in unnitrided condition objectionable rusting of the surface is likely to occur. In the second place, the interalloyed bond between the non-ferrous sheath and the body of the blade is permanent and practically indestructible, eliminating any tendency to peel or crack off during the manufacturing process or in flexing of the blade in use. In the third place, such a non-ferrous sheath is extremely advantageous from the standpoint of hardening and tempering the body of the blade as explained at length in my earlier Patent No. 1,926,861 granted September 12, 1933, since it not only increases the thermal conductivity of the strip, so that the temperature changes required in hardening and tempering are efficiently transmitted to the core of the material, but it relieves the blade material of surface strains and thus improves the blade in flatness and in wear.

These and other features of the invention will be best understood and appreciated from the following description of a preferred method of carrying my invention into effect in producing thin flexible safety razor blades constituting one example of the product of my improved method. In the accompanying drawing,—

Fig. 1 is a view in perspective, partly in cross-section, and on a greatly enlarged scale, of the strip blade stock;

Fig. 2 is a view in perspective of a piece of the strip blade stock in which the outline of the individual blades has been more or less defined;

Fig. 3 is a view in perspective on the scale of Fig. 1 illustrating the blade stock as it appears after the edge grinding operation;

Fig. 4 is a similar view of the blade stock indicating the edge areas hardened by the nitriding step of the process; and

Fig. 5 is a similar view indicating the harden-

ing and tempering of the body of the blade by the heat-treating step of the method.

In manufacturing safety razor blades of the type herein illustrated, I employ copper-clad steel in strip form rolled to an overall thickness of .0060". One satisfactory steel for this purpose is of the following analysis:

Carbon	.60
Manganese	.50
Silicon	.30
Aluminum	1.00
Chromium	1.25
Molybdenum	.20

Steel or ferrous alloys of this general character and having a relatively high percentage of aluminum are referred to under the trade name, "Nitalloy", and many of these alloys are suitable for the purposes of the present invention, it being essential only that the alloy is capable of being hardened by nitriding and also by heat-treatment.

As suggested in Fig. 1 the steel or ferrous body of the blade is reduced to a thickness of approximately .0048". The copper sheath comprising the opposite surfaces of the blade is approximately .0005" in thickness and the alloyed bond, which is partly steel and partly copper, comprises approximately .0001" in thickness. It will be understood that the ferrous and non-ferrous metals are mechanically intermingled or inter-alloyed in the intermediate zone of the bond, the copper content of the alloy decreasing inwardly and the ferrous content of the alloy decreasing outwardly from the ferrous body. Strip stock of the character illustrated in Fig. 1 is relatively soft and may be cut and punched without difficulty.

In carrying out the method of my invention the strip stock is preferably perforated and notched so that the outline of the individual blades is defined therein. In Fig. 2 a strip 10 of such stock is shown and in this individual blades are defined by a series of oppositely disposed edge notches 12, and the blade apertures 14 are also punched in the strip with suitable spacing. It will be understood that the material of the strip 10 shown in Fig. 2 is identical to that shown in Fig. 1 and that the entire upper and lower flat faces of the strip are formed by the copper sheath. It should also be understood that, while it is desirable to form the preliminary shaping steps upon the blade strip at this time, it is possible to delay those operations and particularly the perforating operation up to the time of hardening and tempering the ferrous body of the strip, as will presently appear.

Having prepared strip stock in the manner above explained the next step consists in grinding or rough grinding the blade strip to produce a bevel on one or both edges of the strip. The blades herein shown are of the double edged type and the method will be explained in connection with the production of such blades. It will be apparent, however, that the production of single edged blades would require the bevelling of one edge only of the strip. In either case the effect of the bevelling step is to expose the ferrous body of the strip stock in tapering cross-section at the edge of the strip. The copper sheath remains intact throughout the intermediate portions of the flat faces of the strip, while the alloyed bond is uncovered in a narrow inclined zone with the surface of the exposed ferrous body adjacent thereto.

After the grinding operation the strip stock may be recoiled and placed in a nitriding furnace, where it is subjected to the proper nitriding heat in the presence of ammonia gas for an interval sufficient to nitride the exposed bevel edges of the strip. In some cases a temperature of 1000° to 1150° F. will be found suitable and the nitriding treatment may be continued under these circumstances for a period of approximately two hours with the effect of nitriding the surface portions of the exposed bevel edge of the ferrous body of the strip. The nitrided zones are approximately of the character and shape indicated in Fig. 4, the nitriding action progressing inwardly from the exposed tapering surfaces, so that the extreme cutting edge of the strip is entirely nitrided and also the bevelled faces of the strip which meet in the vertex of the cutting edges. During this step the interior portion of the strip, with the exception of the edges from which the protecting sheath of non-ferrous material has been removed, remains soft and is in suitable condition to be perforated or notched, if these steps have not already been carried out.

The next step of the specific method herein disclosed consists in heat-treating the strip to harden and temper the ferrous body which has been hitherto unaffected. This may be accomplished by conducting the strip through a heating zone in a furnace of a temperature best suited for the composition of the material being used, then quenching the hot strip between water-cooled plates and finally again heating to draw back the stock to the temper desired in the body of the blade. The temperature required for this hardening step is usually between 1430° and 1470° F. and the interval required for heating is no longer than 35 to 40 seconds. Under these conditions I have discovered that there is no loss in the hardness of the edge previously obtained in the nitriding step. Moreover, the strains which have been set up by the nitriding step and the subsequent heating and quenching steps are to a great measure absorbed in the surface sheath of copper. The extreme brittleness incident to the nitriding step as applied to the edge portions of the strip is greatly relieved by the step of hardening and tempering the interior portion of the strip and as a result there is produced a tough and resilient blade having an extremely hard cutting edge supported by a body portion which is flexible and resilient and hardened to a lesser degree.

The tempered strip may now be finished by a slight buffing or polishing operation to which the non-ferrous surface readily responds. Finally, the nitrided cutting edge is subjected to a final honing or stropping step, this being indicated in Fig. 5.

The final step of the method herein outlined consists in breaking off the individual hardened, tempered and polished blades from the strip and this step may be carried out in any well-known or commercial manner. The resulting product is a blade having an edge hardness of from 960 to 1050 Vickers hardness number and with a body portion entirely symmetrical and free from warping or twisting. Moreover, the blade as a whole may exhibit the optimum temper or rigidity required of it and is entirely rust-proof throughout its flat surfaces and rust-resisting in its edge portions on account of the nitrided character thereof.

The steps above discussed may be carried out in different chronological order than is herein set forth depending upon the metallurgical condi-

tion of the bimetallic stock employed. If the grain size of the latter warrants, it may be given a refining heat treatment before nitriding and under these circumstances the sequence of steps may be as follows, scoring and perforating the soft bimetallic strip stock, hardening and tempering to a sorbitic structure, edge grinding, nitriding of the ground edge, a second hardening and tempering of the already nitrided strip, edge honing and stropping and finishing and separating as before.

I have referred herein to copper as an example of one suitable material for the sheath, but other non-ferrous metals would be entirely suitable and may be employed as desired. I wish, therefore, to include within the scope of my invention any non-ferrous metal capable of forming an interalloyed bond with a ferrous base.

An important advantage incident to the use of a copper-clad steel for fine edges is that, since the thermal conductivity of copper is considerably greater than steel, the bimetallic blank may be hardened and tempered with greater efficiency than a blank of solid steel. This will be apparent when it is considered that, in a copper sheathed blank, steel is replaced by copper in those parts of the structure where hardness and temper are not required, that is to say, in the surface portion of the blank.

A further advantage is that the finished blade is relieved completely of residual strain in its surface portions. Since these portions comprise copper, they are substantially unaffected by the hardening and tempering operations and no initial strain is developed in them. The blade, therefore, tends to lie flat without warping or twisting and the soft outside layer of copper acts as a cushion, making the blade more durable and better adapted to stand repeated flexing in use without breakage.

The use of a copper-clad steel for fine edged blades also presents the advantage of a rustproof product, with none of the disadvantages of a plated product in respect to electrolytic corrosion, or tendency to peel. This advantage is particularly noticeable in connection with safety razors of the type in which the blade is sharpened while retained in the razor, as in the auto strop type of safety razor. Heretofore, such blades have been subject to objectionable rusting since they are not always removed and dried after use, but may remain in the razor for a long time, being sharpened repeatedly in the meantime.

Fine edged blades of my invention present the further advantage of an attractive surface finish and thus eliminate the necessity for polishing operations of more than slight extent because the surface of the copper sheath has a cold-rolled surface finish imparted to it which is essentially smooth and which requires no more than a buffing or brightening operation in order to be brought to a high degree of lustre.

Having thus discussed my invention what I claim as new and desire to secure by Letters Patent is:

1. A thin flexible blade of nitralloy sheathed in non-ferrous metal, nitrided in an area adjacent to its cutting edge and having hardened and tempered supporting portions.

2. A safety razor blade comprising a thin flex-

ible wafer of nitralloy sheathed in non-ferrous metal and internally apertured, nitrided in areas adjacent to its cutting edge and hardened and tempered in an interior area including its internal aperture.

3. A safety razor blade comprising a thin flexible wafer of copper-clad nitralloy having a nitrided area including its cutting edge and a hardened and tempered inner area merging into the same.

4. A safety razor blade made of copper-clad nitridable alloy and comprising a thin flat flexible and resilient body portion of substantially uniform thickness and an acutely tapered cutting edge portion integral therewith, said blade being nitrided in an area adjacent to and including its tapered cutting edge and hardened and tempered in adjacent interior areas.

5. A cutting blade of nitridable alloy having a hardened and tempered body portion enclosed in a non-ferrous alloy united thereto by a bonding layer of said alloys mechanically intermingled and having a nitrided cutting edge.

6. A cutting blade of nitridable alloy enclosed throughout its intermediate area within a non-ferrous sheath united thereto by a bonding layer of said alloys mechanically intermingled and co-extensive with the sheath and hardened and tempered within said sheath, and having a nitrided beveled cutting edge portion.

7. The method of making blade strip for use in the manufacture of fine edge blades, characterized by the steps of edge grinding a strip of copper-sheathed nitridable stock to expose a narrow marginal edge beyond the copper of the sheath, nitriding said edge, and then, after such nitriding step, hardening and tempering the sheathed portion of the stock.

8. The method of making cutting implements, which consists in nitriding the edge portions of a blank sheathed in non-ferrous metal and forming a cutting edge therein, and then reducing abrupt change in the hardness of the edges and body portions by hardening and tempering the body portion after such nitriding step.

9. The method of making strip blade stock, which consists in edge notching copper-clad nitralloy strip to define individual blades, rough grinding an edge of the stock, nitriding the ground edge thereof, and hardening and tempering the unground portions after such nitriding step.

10. The method of making blades, which consists in edge grinding copper-clad nitralloy strip, nitriding the ground edge of the strip, perforating the unnitrided portion of the strip, heat treating the same to harden and temper it after such nitriding step, and finally dividing the strip into individual blades.

11. A thin flexible safety razor blade comprising a body of nitridable ferrous alloy having a tough resilient temper and alloyed sheath presenting a polished non-ferrous surface, and a nitrided beveled cutting edge of not less than 900 Vickers hardness number, the tempered area of the body and the nitrided area of the cutting edge being directly juxtaposed in the integral blade structure.

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