

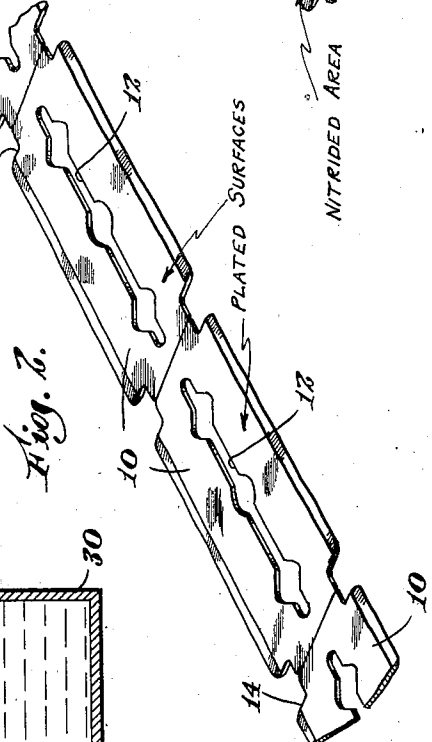
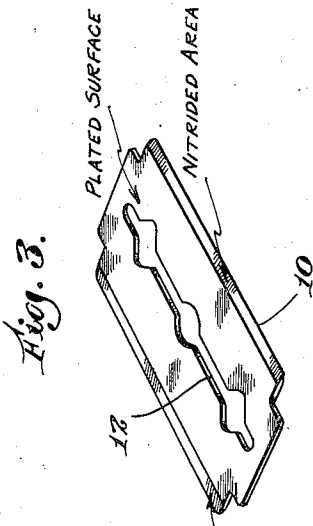
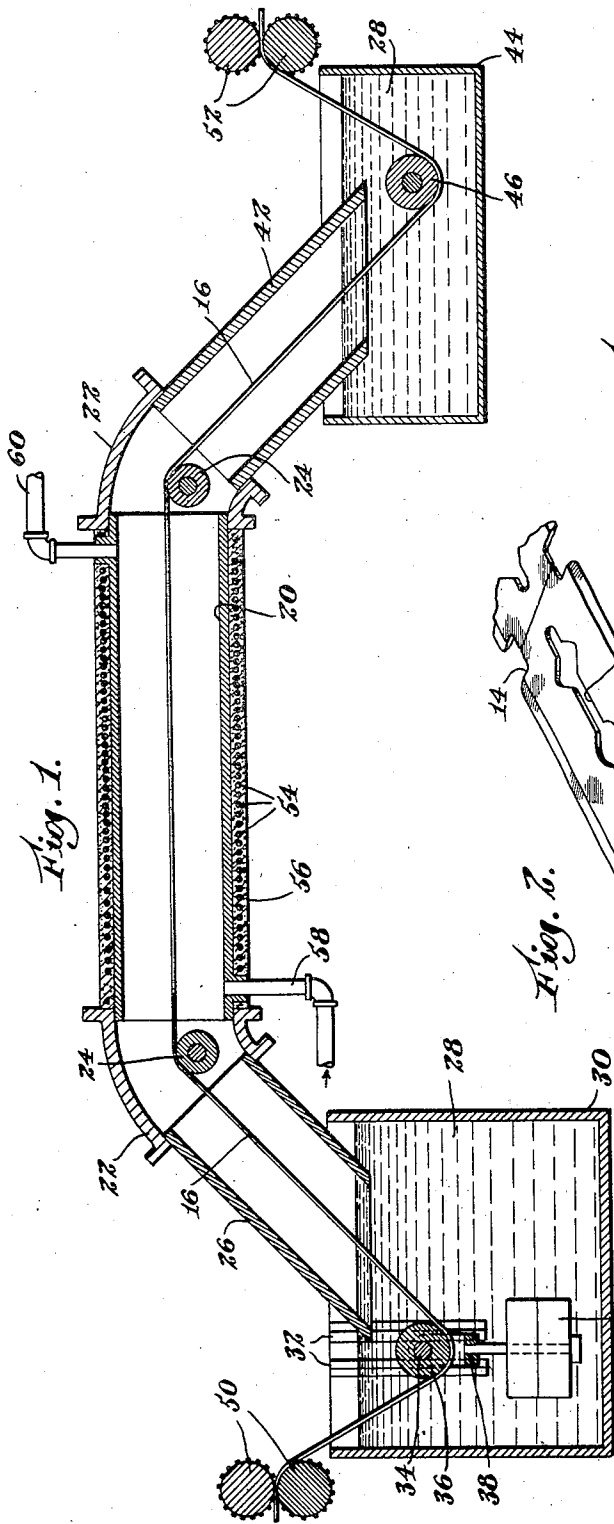
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BLADE STRIP AND METHOD OF MAKING THE SAME

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BLADE STRIP AND METHOD OF MAKING
THE SAME

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9 Claims. (Cl. 148—16)

This invention relates to the manufacture of fine edged blades of ferrous alloys which may be hardened by the process of nitriding, that is to say, by introducing nitrogen into, or causing it to combine with, the alloy. In one aspect my invention comprises a new and improved method of making such blades in strip form. In another aspect it comprises a novel blade strip herein shown as produced by the method of my invention.

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. In my prior Patent No. 1,827,780, granted October 20, 1931, I have disclosed a safety razor blade with nitrided cutting edges, this being the first example in the art of a nitrided cutting edge, and from another standpoint the present invention consists in a further development of my earlier invention above identified.

The material I prefer to employ in the construction of the novel blade strip, and in carrying out the improved method of my invention, is a ferrous alloy containing a substantial amount of aluminum, usually combined with chromium or molybdenum or tungsten. An example of such alloy is the material commercially known as nitralloy, and, while this may be advantageously employed in manufacture of fine edged blades, other ferrous alloys capable of being hardened by the process of nitriding and otherwise answering to the requirements of the blades to be produced might be used.

In the nitriding operation as heretofore carried out, difficulty has been experienced in preserving the shape of the blank in the hardened blade on account of the fact that a local expansion of the material apparently takes place in the nitriding operation, which tends to warp or distort the blade to an objectionable extent. Blades nitrided throughout their entire area, particularly thin flexible blades, are usually too brittle for practical purposes. This is particularly true of such an article as a flexible razor blade which is commonly maintained in a position of pronounced transverse curvature when in use, and must therefore be capable of withstanding appreciable bending stress.

I have discovered that if the nitriding operation is carried out upon a blank which is in the meantime maintained under tension the objectionable tendency to distort, above discussed, is eliminated or reduced to a negligible amount. My invention accordingly is characterized by

the step of subjecting a strip or a blank of a nitridable ferrous alloy to the combined action of heat and ammonia, and simultaneously maintaining the strip or blank under tension. In other words, I propose to effect the nitriding operation while the strip is maintained in a state of tension, and under these conditions the readjustment of the nitralloy in the nitriding operation does not produce the distortion of the flat strip which would otherwise occur. The amount of tension to which the blank is subjected may be varied within convenient limits, but preferably will not exceed the elastic limit of the alloy at the degree of heat to which it is subjected.

An important advantage of the method above outlined is that it lends itself to continuous-process operation and therefore may be carried out with marked economy, particularly in those cases where the material to be treated is available in long strips or ribbons. Under these conditions the tensioned strip may be moved through a heated ammonia container at such a rate as to cause the nitriding operation to progress to the desired point during the passage of the strip through the container. The process of my invention may also be advantageously applied to the production of strips or blanks which are nitrided in portions only of their entire area. For example, in the manufacture of safety razor blades it is desired to nitride only the narrow marginal zone including the cutting edge, and to leave the body of the blank unnitrided, and consequently ductile in its character. This may be accomplished in accordance with another feature of my invention by protecting the strip or blank in any desired manner between its marginal edges. As herein shown the body of the strip is protected by a coating or plating impervious to nitrogen and the ferrous alloy is exposed only in the narrow marginal zones of the strip. It will be understood, however, that it would be within the scope of my invention to protect the body of the strip by any means which is effective to prevent or reduce the nitriding operation in selected areas.

My invention may be practiced in the treatment of continuous strips or ribbons of ferrous alloy, or of strips in which the outline of the blanks has been partially outlined by punching or trimming, or which has been perforated or otherwise partially prepared for the ensuing steps in its manufacture. For purposes of illustration I have herein shown a blade strip having a succession of blade areas set off herein by spaced edge notches in the strip and in the nitriding operation the narrow edge zones, included individ-

ual between consecutive notches are hardened while the body of the strip between its marginal edges remains unnitrided and consequently ductile in its character. It will be apparent that in accordance with the method of my invention strips of the character described may be prepared in quantity and stocked in coils in readiness for the further steps converting them into individual blades.

- 10 These and other features of my invention will best be understood and appreciated from the following description of its application to the manufacture of a blade strip for use in the manufacture of safety razor blades as illustrated in the accompanying drawing in which:

Fig. 1 is a view in longitudinal section, somewhat diagrammatic in character, of one form of apparatus which may be used in carrying out the method of my invention in which the blade strip is shown in the nitriding step.

Fig. 2 is a view in perspective of a portion of the blade strip.

Fig. 3 is a similar view of a finished blade.

- In manufacturing safety razor blades by the method of my invention herein illustrated the blade blanks 10 are first outlined in strip form. As shown in Fig. 2 this may be done by punching or dieing out suitable edge notches and perforations in a continuous strip or ribbon of nitralloy or other nitridable alloy which may be secured commercially, rolled to the desired thickness. As herein shown each blade blank is provided with an internal aperture 12 in the shape of a slot intersecting recesses, and with cut-out portions forming corner notches 14 which, in the finished blade, obviate the possibility of corner pressure from the cap of the razor. The strip may be scored or otherwise marked to set off one blank from the next. These steps and those following being carried out upon the material in continuous strip form.

The material employed in the strip described above may be selected as already intimated. Either of the following analyses are satisfactory.

Element	Analysis A	Analysis B
Carbon.....	.36	.23
Manganese.....	.51	.51
Silicon.....	.27	.20
Aluminum.....	1.23	1.24
Chromium.....	1.49	1.58
Sulphur.....	.010	.011
Phosphorus.....	.013	.011
Molybdenum.....	.18	.20

- In those cases where the blade strip is protected from the nitriding action between its marginal edges by a coating or plating, I have found non-ferrous metals such as tin, copper, silver, nickel, chromium, and possibly others, to be effective. Accordingly in the accompanying drawing the blade strip is shown as having plated surfaces which are terminated at each margin of the strip by a ground bevel which exposes the ferrous alloy. Preferably a strip may be prepared by electroplating its entire surface, together with its exterior marginal edges and interior edges of the apertures 12 and then having the plating removed by grinding along its marginal edges.

- Having prepared the blade strip in the manner above outlined, it is ready for the nitriding operation which may be effectively carried out by apparatus which will now be described.

The apparatus comprises, broadly, an elongated heated chamber, or furnace liquid sealed

at each end and provided internally with guides for the tensioned blade strip, together with means for admitting and discharging ammonia gas to the heated and tensioned strip. The furnace comprises a horizontally disposed pipe 20 provided at either end with a special cast fitting or elbow 22, each directed downwardly at an angle of substantially 45°. Each of the fittings 22 is provided with an idle guide roll 24 disposed so as to direct the blade strip, which as a whole is indicated by the reference character 16, in a path coinciding substantially with the longitudinal axis of the pipe 20.

The fitting 22 at the left or entering end of pipe 20 is provided with a downwardly extending pipe 26 which, at its lower end is arranged to extend beneath the surface of oil 28 contained in a tank 30. The tank 30 is provided upon opposite walls with parallel vertically disposed guide strips 32 in which is mounted a horizontal spindle 34 carrying a roller 36 and having suspended from its ends a yoke 38 with a downwardly extending stem upon which is supported a weight 40. The fitting 22 at the right hand or discharging end of the furnace is provided with the downwardly extending pipe 42 bevelled at its lower end and extending beneath oil 28 in a tank 44. The tank 44 is provided with journal bearings for a roll 46 which is maintained in a fixed position entirely submerged by the oil.

The blade strip 16 is delivered to the roll 36 at the entering end of the apparatus from a pair of positively driven feed rolls 50 which advance the blade strip at a definite uniform rate. Upon leaving the tank 44 at the delivering end of the apparatus the blade strip is fed between two similar positively driven feed rolls 52 which are operated to deliver the blade strip from the apparatus at the same rate at which it is delivered thereto. The length of the strip maintained between the two sets of feed rollers is regulated so that the weighted roll 36 will be at all times suspended from it, and the entire blade strip between the feed rolls will thus be maintained under a uniform and controllable degree of tension. This may be regulated, as may be apparent, by reducing or increasing the size of the weight 40. The blade strip is thus stretched tightly between the guide rolls 24 and in the portion of its path between these guide rolls and the feed rolls at either end of the apparatus. Moreover, since the rolls are all of plain cylindrical shape the blade strip is flattened by its contact with them.

The feeding and tensioning of the blade strip has now been described. The heating thereof is effected in the apparatus illustrated by encircling the pipe 20 with a coil of resistance wire 54 embedded or covered with insulating material 56. By the passage of an electric current through this coil the pipe 20 may be heated to any desired temperature and maintained uniformly thereat. A temperature of 950° F. to 1400° F. for the interior of the pipe, 20 has been found satisfactory in practice and permits the blade strip to be fed at a convenient rate of speed.

The heated pipe 20, together with the fittings 22, and the inclined pipes 46 and 42 constitute a fluid sealed container to which ammonia may be supplied conveniently in the form of gas. As herein shown, ammonia is delivered to the left hand pipe 20 through a small pipe 58 leading into the bottom thereof, and it is discharged from the apparatus through a pipe 60 of similar size leading from the upper side thereof near the right hand end.

It should be pointed out in connection with the apparatus above described that the pipe 20 may be of any convenient length and that it forms a very effective container for ammonia in contact with the blade strip being treated. This is particularly advantageous from the standpoint of economy in that the waste of ammonia by dissociation on account of contact with heated areas is reduced to a minimum while the ammonia supplied to the apparatus is utilized to maximum effect in connection with the blade strip.

It should be further pointed out that the apparatus herein disclosed, and the method of its use, permits considerable flexibility, and consequently are useful in producing blade strips of differing characteristics. For example, the rate of feed of the blade strip through the apparatus may be varied within wide limits so that the length of the nitriding process may be regulated in this manner. Again, the temperature of the pipe 20 may be regulated so that the heat at which the nitriding process takes place may be varied to produce any desired effect. As a general thing, and between definite limits, the higher the temperature and the longer the operation, the greater the volume of nitrided material produced. As indicating a workable range, it may be stated that a nitriding operation at a temperature of 1100° F. extended for a period of 15 minutes will ordinarily nitride and harden the marginal edges of a blade strip sufficient for the manufacture of razor blades.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is—

1. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of subjecting a longitudinal zone in a strip of nitridable ferrous alloy to the combined action of heat and ammonia, thereby nitriding the strip in said zone, and simultaneously maintaining the strip under longitudinal tension thereby substantially reducing distortion in the strip during the nitriding operation.

2. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of tensioning a strip of nitridable ferrous alloy, and nitriding longitudinally disposed portions thereof while the strip is maintained under tension, thereby substantially eliminating distortion of the strip during the nitriding operation.

3. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of protecting a strip of nitridable ferrous alloy between its marginal edges and simultaneously heating and treating the strip with ammonia while maintaining it under tension, thereby nitriding the unprotected edges of the strip without distorting the strip.

4. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of plating the surface of a strip of a nitridable ferrous alloy, beveling an edge thereof to expose said alloy in a narrow zone and simultaneously heating and treating the strip with ammonia while maintaining it under tension, thereby nitriding the beveled edges of the strip without distortion.

5. The method of manufacturing blades having nitrided cutting edges, characterized by the step of continuously moving a tensioned strip of a ferrous nitridable alloy, protected between its marginal edges, through a heated ammonia container, thereby nitriding the edges of the strip without substantial distortion.

6. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of flattening a strip of nitridable ferrous alloy at separated points in its length, tensioning the strip between said points and subjecting a marginal portion of said tensioned strip to the combined action of heat and ammonia, thereby nitriding the treated portion of the strip while the latter is held flat against distortion.

7. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of heating a strip of a ferrous nitridable alloy, tensioning the heated strip to a point below the elastic limit of the heated alloy at that temperature, thereby maintaining the strip in a flat condition and then nitriding the marginal portions of the heated and tensioned strip, thereby substantially eliminating distortion due to nitriding.

8. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of outlining the blade blanks in the strip, protecting the surface of the strip between its marginal edges from the action of ammonia, heating the strip to between 950 degrees and 1400 degrees Fahrenheit, tensioning the heated strip to a point below the elastic limit of the alloy at that temperature, and then nitriding the unprotected edges of the tensioned strip, thereby substantially eliminating distortion due to nitriding.

9. The method of manufacturing blades having nitrided cutting edges, characterized by the steps of outlining the blade blanks and the apertures thereof in a strip of a ferrous nitridable alloy, plating said strip, rough grinding its edges to expose the alloy in narrow marginal zones, heating said strip while maintaining it under tension and simultaneously subjecting it to the action of ammonia gas, thereby nitriding the edges of the strip without distortion due to nitriding, finishing grinding the edges thus nitrided, and then separating the strip into individual blades.

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