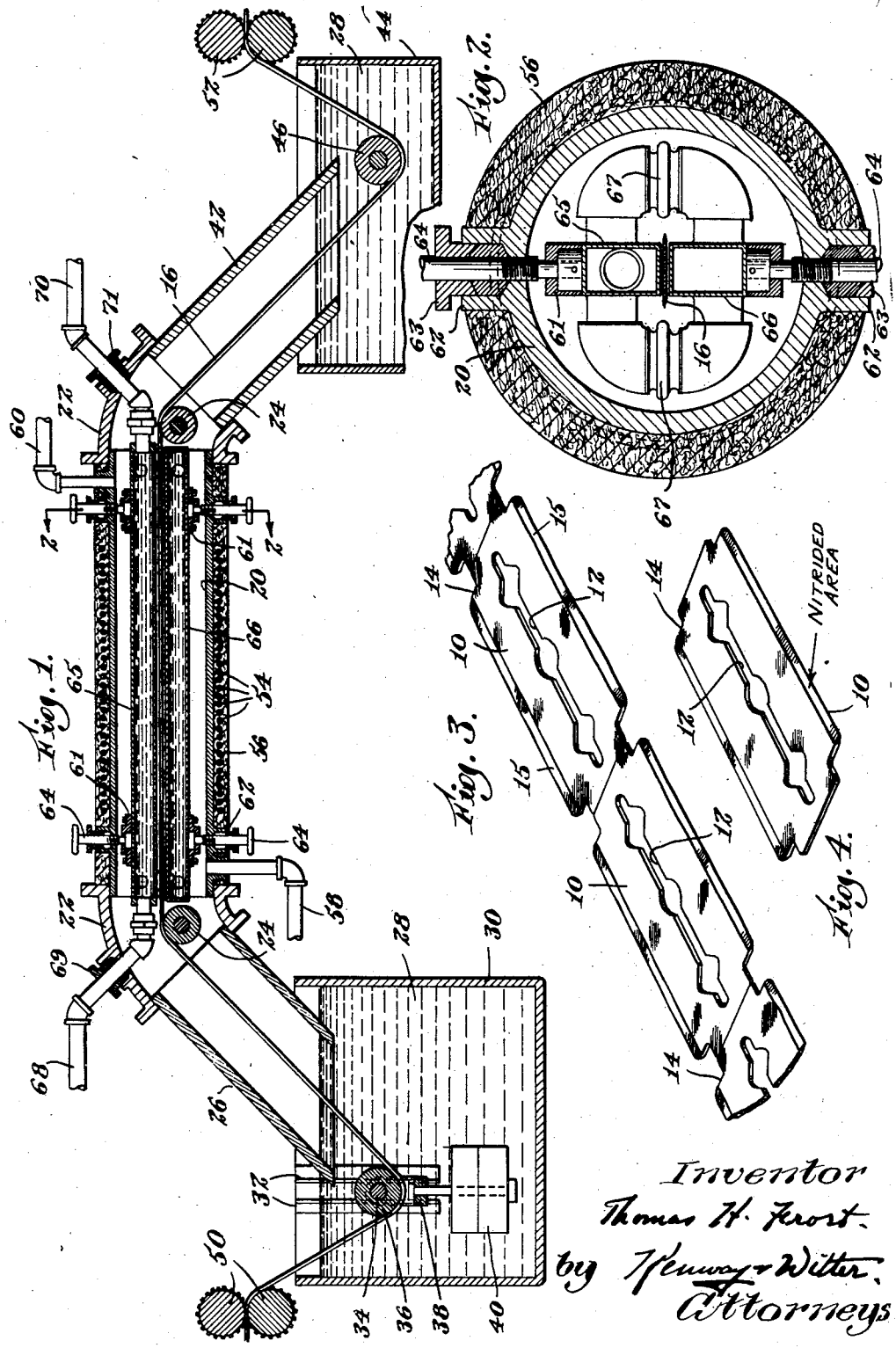
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MANUFACTURE OF FINE EDGED BLADES

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MANUFACTURE OF FINE EDGED BLADES

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This invention relates to improvements in the manufacture of fine edged blades and blade strips 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 apparatus herein shown as employed in the practice of 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 the nitriding operation as heretofore carried out difficulty has been experienced in preserving the shape of the blank in the nitrided and hardened blade on account of the fact that a local expansion of the material is likely to take place which tends to warp or distort the blade to an objectionable extent. Blades nitrided through their entire area, particularly thin flexible blades, are usually too brittle for practical purposes. Accordingly it has been the practise to protect the blank between its edges by a coating or plating of material impervious to nitrogen so that the nitriding operation is confined to narrow marginal zones in the blade. Under these circumstances the hardened nitrided material is distributed upon the more ductile body of the blade and the resulting article as a whole is thereby rendered serviceable.

The primary object of the present invention is to provide a method by which blade strips may be nitrided in either or both marginal edges only without the necessity of plating or otherwise coating the strip preparatory to the nitriding operation. I have discovered that this may be accomplished by subjecting a strip of ferrous nitridable alloy to the action of a nitriding agent within a heated container and simultaneously cooling a selected area in the strip to a temperature below that at which a nitriding action will take place, or preventing such areas from becoming heated to that degree. For example, in the case of certain alloys a temperature of approximately 950° F. is sufficient to cause ammonia gas to nitride the exposed and heated portions, whereas below that temperature little or no nitriding effect can be detected. Accordingly I propose to maintain an intermediate zone in the blade blank or strip below the temperature of 950° F. while heating the marginal portions of the strip to or above that temperature. The result is that the marginal portions of the strip will become fully nitrided and hardened, whereas the intermediate portion thereof will retain its original relatively soft and ductile characteristics.

The method of my invention is of particular advantage in that it lends itself to continuous-process operation and may therefore 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 strip may be moved through a heated ammonia container provided with a cooling medium of less width than the blade strip which will be effective to maintain the selected area in the strip below the critical temperature.

Another advantage of my improved method is that it may be carried out if desired upon a strip which is maintained under tension during its passage through the heated container. This, as explained in my prior application Ser. No. 506,423 filed January 3, 1931, is one effective manner of obviating distortion in the blank during the nitriding operation. From this standpoint the present invention consists in a development or carrying forward of the principles disclosed in said application with a view to increasing its field of use and economy of operation.

While the method of my invention may be practised with the assistance of apparatus of various descriptions, I have herein disclosed one form which may be used with entire satisfaction and such apparatus is included within the scope of the present invention. As herein shown, this apparatus comprises a heated container which may be charged with a nitriding agent and in which is disposed an elongated cooling medium of less width than the strip to be treated, disposed closely adjacent to the path of movement of the strip and being effective to cool or to prevent heating of that portion of the strip located opposite to it. Preferably the cooling medium is arranged for adjustment to and from the path of the blade blank or strip so that its cooling effect may be regulated and the width of the unnitrided zone varied in accordance with the requirements of the case.

I have found it effective to provide oppositely disposed water cooled ducts between which the blade strip is arranged to be guided and to arrange these ducts for individual adjustment to or from the path of the blade strip. This permits a flexibility of adjustment which increases the capacity of the apparatus to produce blade strips of the desired characteristics.

These and other features and characteristics of my invention will be best understood and appreciated from the following description of its application to the manufacture of blade strip for use in the manufacture of safety razor blades as illustrated in the accompanying drawing in connection with the apparatus referred to and in which;

Fig. 1 is a view in longitudinal section, somewhat diagrammatic in character, of the apparatus, showing the blade strip in the nitriding step.

Fig. 2 is a view on an enlarged scale of the apparatus in cross section upon the line 2—2 of Fig. 1.

Fig. 3 is a view in perspective of a portion of the blade strip, and

Fig. 4 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. 3 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 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 the step of rough grinding the strip to form bevels 15 being carried out upon the material in continuous strip form.

The material employed in the strip described above may be selected from alloys of suitable analysis, such for example as either of the following:

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

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 charged with a nitriding agent, liquid-sealed at each end and provided with guides for a tensioned blade strip, together with an elongated cooling medium arranged to act upon the strip as it is passed through the furnace. The furnace comprises a horizontally disposed pipe 20 provided at either end with a special fitting or elbow 22 directed downwardly at an angle of 45 degrees. Each of the fittings 22 is provided with an idle guide rod 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 practise 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.

In order to protect the intermediate portion of the blade and maintain it at a temperature below that at which the nitriding operation will take place the pipe 20 is provided with a pair of longitudinally disposed ducts 65 and 66 substantially rectangular in cross section. The upper duct is adjustably supported in a position above the path of the blade strip 16 by a pair of threaded stems 64. These extend outwardly through bosses 62 in the pipe and through a packing gland 63 and each is provided at its outer end with a hand wheel. The inner end of each stem makes a swivel connection with a cap plate 61 secured to the upper surface of the duct 65, the construction being such that by turning the threaded stems the duct 65 may be adjusted vertically at each end and thus caused to lie nearer to or further from the upper surface of the blade strip 16. The lower duct 66 is mounted for adjustment by similarly threaded stems 64 beneath the blade strip. The two ducts 65 and 66 are connected at either end by a pair of flexible unions 67 which permit relative movement.

Cooling water is supplied to the upper duct 65 through a supply pipe 68 and discharged at its opposite end through a delivery pipe 71. The supply pipe 68 enters the left-hand fitting 22 through a gland 69 and the delivery pipe 70 leaves the right-hand fitting 22 through a gland 71 constructed to permit a slight movement of the pipe when the duct is adjusted and to maintain the whole container substantially gas-tight.

The cooling ducts 65 and 66 are of less width than the blade strip and are located with respect to it so that the marginal portions only of the strip are fully exposed to the heat of the furnace. This arrangement is best shown in Fig. 2 from which it will be plain that little more of the blade strip than the bevelled portions project laterally beyond the sides of the cooling ducts. It will be seen that the blade strip is thus shielded in a wide intermediate zone from the heat of the furnace and by adjusting the position of the cooling ducts and regulating the temperature and flow of the cooling water it is possible to maintain this portion of the strip at a temperature below that at which the nitriding can take place. The blade strip therefore emerges from the apparatus with its body portion soft and ductile and with its marginal edges nitrided to the desired degree.

The pipe 20 may be of any convenient length and 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 and varied to produce the desired effect. As indicating a workable range of temperature 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.

It may be further noted that the novel method of my invention is of particular advantage from the standpoint of ammonia consumption in that the loss caused by dissociation of the ammonia due to contact with highly heated surfaces is reduced to a minimum by the employment of cooling mediums coextensive with the blade strip.

Having completed the nitriding operation in the manner above outlined, the blade strip may be subjected to a final sharpening operation and may then be cut or broken on the scored lines into its individual component blades.

While I have illustrated the method of my invention as being carried out upon blade strips, it will be apparent that many of its steps are applicable to blade blanks not necessarily in strip form.

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 making blade strip for use in the manufacture of fine edged blades, which consists in subjecting a strip of ferrous nitridable alloy to the action of ammonia, heating a marginal portion of the strip, and simultaneously maintaining an intermediate portion thereof at a temperature below that at which nitriding will take place.

2. The method of making blade strip for use in the manufacture of fine edged blades, which consists in subjecting a strip of ferrous nitridable alloy to the action of ammonia, and simultaneously heating a marginal portion of the strip to a temperature above 950° F. while maintaining an intermediate portion thereof below nitriding temperature.

3. The method of making blade strip for use in the manufacture of fine edged blades, which consists in subjecting a strip of ferrous nitridable alloy to the action of a nitriding agent within a heated container, and simultaneously cooling a selected area in the strip sufficiently to prevent a nitriding action in said area.

4. The method of making blade strip for use in the manufacture of fine edged blades, which consists in passing a strip of nitridable ferrous alloy through a heated container having a nitriding agent therein, and simultaneously subjecting less than the full width of the strip to the action of a cooling medium to prevent nitriding therein.

5. The method of making blade strip for use in the manufacture of fine edged blades, which consists in feeding a strip of nitridable ferrous alloy through a heated and ammonia-charged container, and simultaneously cooling the opposite faces of the strip between its margins in selected areas to a temperature below that at which nitriding takes place.

6. The method of making blade strip for use in the manufacture of fine edged blades, which consists in feeding a strip of nitridable ferrous alloy through a heated and ammonia-charged container, maintaining the strip under tension, and at the same time cooling an intermediate zone therein below nitriding temperature.

7. The method of making blade strip for use in the manufacture of fine edged blades, which consists in passing a strip of nitridable ferrous alloy through an atmosphere of ammonia heated to a temperature sufficient to effect in the alloy a nitriding operation, and simultaneously maintaining a selected area of the strip below such critical temperature.

8. The method of making blade strip for use in the manufacture of fine edged blades, which consists in subjecting a beveled-edged strip of ferrous nitridable alloy to the action of a nitriding agent within a heated container, and simultaneously embracing the body of the strip between oppositely disposed cooling mediums which maintain the body of the strip unnitrided while the edges thereof become nitrided.

9. The method of making fine edged blades, which consists in subjecting a bevel-edged blank of ferrous nitridable alloy to the action of a nitriding agent within a heated container, shielding the body of the strip between cooling mediums in such manner as to expose only the beveled edges thereof to nitriding temperature, and meanwhile maintaining the strip under tension.

THOMAS H. FROST.