

[54] KNITTING MACHINE NEEDLE BED

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[58] Field of Search **66/110, 115; 29/527.4, 527.6,
29/530**

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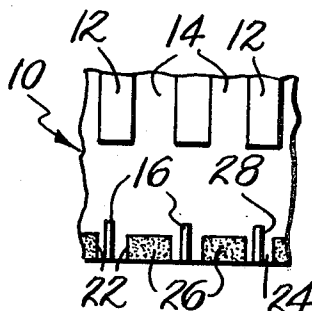
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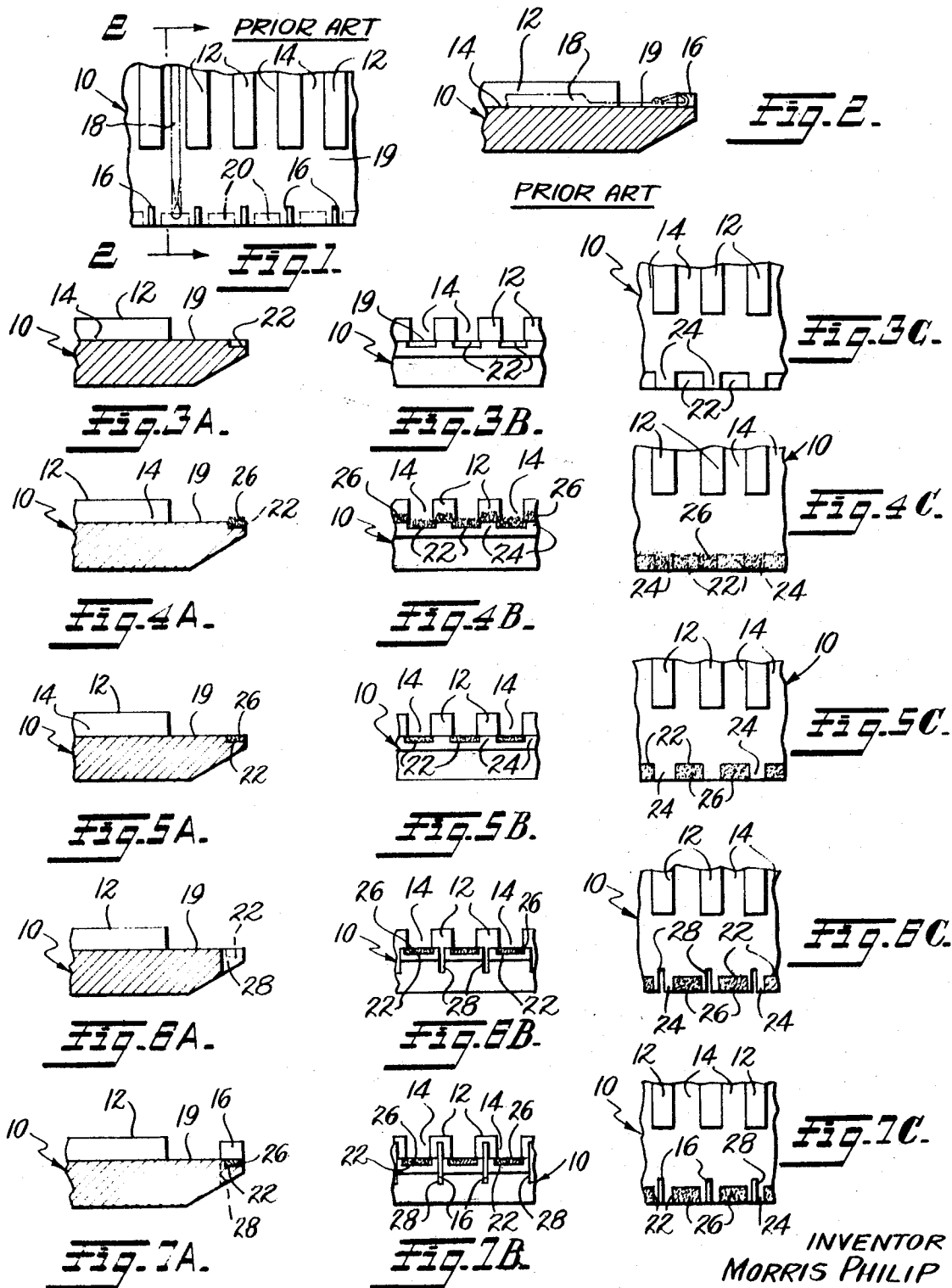
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ABSTRACT

A knitting machine needle bed is provided with a hard wear surface by removing metal in the areas subjected to heavy wear, introducing hard material in such areas, and grinding the hardened material down to the proper level. The hard material is deposited in particulate, liquid or vapor form and becomes substantially integral with the base. If combining teeth are to be inserted, the hard material is ground away in the appropriate areas, which are then slotted for the insertion of the combining teeth.

13 Claims, 22 Drawing Figures





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Fig. 8.

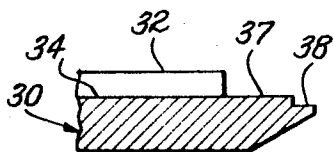
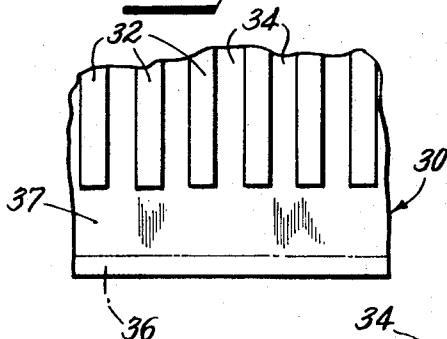


Fig. 9.

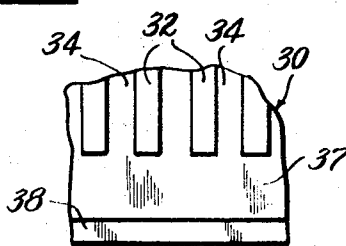


Fig. 10.

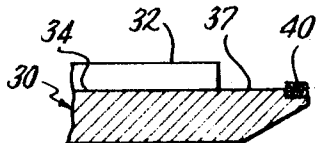


Fig. 11.

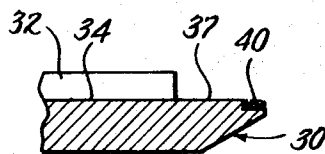


Fig. 12.

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KNITTING MACHINE NEEDLE BED

This invention relates to a knitting machine needle bed and method of producing same. More particularly, the invention is directed to a knitting machine needle bed wherein there is a specially provided hard wear surface at the forward edge of the needle bed and the method of providing this hard wear surface.

In knitting machines of all types, whether they be cylinder machines, dial or cylinder, or dial and cylinder, or flatbed machines, the portion of the needle bed which gets the greatest wear is the forward edge of the bed, this being the edge immediately beneath the hooks of the needles. The weight of the take up pull on the fabric and the yarn pulling against the needle pull the hook against this forward edge and this pulling action tends to pivot the needle about the forward edge to slightly raise the rearward portions of the needle. Because of this it is the forward edge which receives the greatest wear. The constant friction of the needle against the forward edge rapidly wears down the forward edge, necessitating replacement of the needle bed.

Because of this great wear at this forward edge, hereafter called the wear surface, attempts have been made to specially harden this wear surface. A needle bed is made of a relatively large piece of steel and has to be machined to provide the needle grooves, the overall shape, etc., and because of the extensive machining involved, the steel must obviously be machinable and therefore relatively soft. In the prior art, needle beds have been machined from such relatively soft steel and then the final bed is hardened by various techniques known in the steel industry. During the hardening of the entire bed, which generally involves heat treatment, the bed frequently loses its shape or at least its accuracy. To avoid this distortion and the problems involved in hardening the entire bed, attempts have been made to flame harden the bed in the locations where hardening is most necessary. However, flame hardening is not always uniform and the hardened surface wears out relatively rapidly. Besides the various shortcomings of the various methods of hardening the bed, the hardness achieved is always limited by the hardness which can be imparted to the steel.

According to the present invention, special hard material is inserted into the bed at the wear surface and it is possible to insert material such as, for example, tungsten carbide, which is extremely hard and harder than any hardened steel. The wear surface can be made of materials so hard, in fact, that they cannot be cut by milling and the like but can only be shaped by grinding with special diamond grinders. Needle beds made with such inserts have a useful life many times longer than the life of any beds made with hardened steels. Because of the difficulty in shaping the superhard material used in the invention, it is a particular problem of the invention to provide the hardened wear surface and at the same time make provision for the insertion of the combing teeth in the needle bed.

Therefore, according to one aspect of the present invention, there is provided a metal needle bed having a plurality of laterally spaced apart upstanding needle retaining walls defining therebetween needle channels, and a hard wear surface on the upper surface of the forward edge of said bed, the upper level of said wear surface being about even with the bottoms of said needle channels, said hard wear surface being located in at least laterally spaced apart areas aligned with said needle channels, said hard wear surface being formed of a material harder than the metal of said bed having been inserted into said bed. The hardened wear surface can extend along the entire edge of the needle bed in those machines where combing teeth are not necessary. In machines where combing teeth are to be provided, said harder material is inserted substantially only in the areas aligned with the needle channels, and in the intervening areas, aligned with the needle retaining walls which define the channels, there can be inserted the combing teeth.

According to another aspect of the invention, there is provided a method of producing a needle bed having a hard wear surface at a predetermined level on the upper surface of the forward edge of said bed, said predetermined level being

about even with the bottom of the needle channels of the bed, comprising the steps of providing a metal needle bed blank; removing metal from the upper surface of the forward edge of said blank, said metal being removed in at least laterally spaced apart areas corresponding to the needle channels of the finished needle bed, said metal being removed to a depth below said predetermined level; inserting a material harder than the metal of said blank at least into the spaces from which the metal was removed, said harder material being inserted to a height above said predetermined level; grinding the upper surface of said harder material down to said predetermined level; and forming laterally spaced apart upstanding needle retaining walls in said blank rearward of said areas at any time subsequent to step providing the bed blank, said walls defining therebetween needle channels, said channels being aligned with said areas, the bottom of said needle channels being at about said predetermined level. When the needle is to have combing teeth, the metal in the intervening areas between the spaced apart areas is left at a height at least as high as said predetermined level and the harder material is applied, to a height about the predetermined level, along the entire edge. The edge is then ground down to the predetermined level, a groove is cut into each intervening area, and combing teeth are inserted into the grooves.

These and other aspects of the present invention will be readily apparent from the following description in connection with the accompanying drawings, wherein:

FIG. 1 is a fragmentary top elevation of the forward portion of a prior art needle bed;

FIG. 2 is a cross section of the needle bed of FIG. 1 taken on line 2—2;

FIGS. 3A, 4A, 5A, 6A and 7A are fragmentary cross sections of the forward end of a needle bed taken along the line of a needle channel showing the steps of one embodiment of the process of the invention;

FIGS. 3B, 4B, 5B, 6B and 7B are fragmentary front elevations of the needle bed showing the steps of FIGS. 3A through 7A, respectively;

FIGS. 3C, 4C, 5C, 6C and 7C are fragmentary top elevations of the forward end of a needle bed showing the steps of FIGS. 3A through 7A, respectively.

FIG. 8 is a fragmentary top elevation of the forward portion of a needle bed of another embodiment of the invention;

FIG. 9 is a fragmentary cross section of the front end of a needle bed showing a step in a modified process;

FIG. 10 is a fragmentary top elevation of the forward portion of a needle bed showing the step corresponding to FIG. 9;

FIG. 11 is a fragmentary cross section of the front end of a needle bed showing the next step in the modified process of FIG. 9;

FIG. 12 is a fragmentary cross section of the front end of a needle bed showing the next step in the modified process of FIG. 9.

The invention is particularly applicable to circular needle beds, such as dials and cylinders, but for the sake of convenience the invention will be described in connection with a flat needle bed.

Referring to FIGS. 1 and 2, which show standard prior art flat needle beds, the needle bed 10 comprises a plurality of laterally spaced apart upstanding needle retaining walls 12, adjacent walls defining between them needle channels 14. At the forward edge of the needle bed there are provided laterally spaced apart upstanding combing teeth 16, said combing teeth being longitudinally aligned with the needle retaining walls. Needles 18 are positioned in channels 14 with the needle hook being at the forward edge of the bed between combing teeth 16. The surface 19 represents the bottoms of the needle channels and the needle slides or reciprocates on this bottom. Note that the upper surface of the forward end of the needle bed, at least in line with the channels, is at the same level as the channel bottoms.

As the needles reciprocate in the needle bed and the yarn and fabric are hooked onto the needles, the pulling of the yarn

and the weight of the take up pull on the fabric pull the needles downwardly so as to cause the greatest wear on the surface of the needle bed at the forward edge of the needle bed. These areas which receive the greatest wear are shown at 20, outlined in phantom. These areas 20 are at the forward edge of the needle bed and correspond to, that is, are aligned with, needle channels 14. It is the purpose of this invention to provide this needle bed with special hard material in these areas which receive the excessive wear. Before proceeding to describe the invention, certain terms will be defined particularly to show their applicability to needle beds such as cylinders and dials.

The word "forward" refers to that end of the bed where the needle hooks are positioned, while "rearward" refers to the direction opposite from the forward or hook end. Since cylinders are usually thought of as being vertical with the hooks at the upper end, the word "forward" as used herein will refer to the upper end of such a cylinder, and "rearward" will therefor refer to the downward direction of such a cylinder. Dials are generally of two types, one type being that in which the needle hooks are positioned at the outer periphery, and the other type having the needle hooks positioned at an inner periphery. In both cases the periphery at which the hooks are located will be considered the "forward" end.

The word "lateral" refers to a direction parallel to the forward edge of the needle bed, that is, a direction transverse to the needle channels. Therefore, in a dial "lateral" would be a circumferential direction in the plane of the dial. "Lateral" in a cylinder would be circumferential direction around the cylinder. In the illustrated embodiment, a flat needle bed, the needle retaining walls, and therefore the needle channels, are substantially parallel and they are normally also parallel or substantially parallel in a cylinder. In a dial the needle retaining walls, and the channels run radially of a dial and the walls are therefore frequently tapered to provide channels of uniform width. Therefore, in a dial the wear areas 20 and the combing teeth 16 still correspond to or are aligned with the needle channels and the retaining walls, although the lines defining the alignment are radial lines rather than parallel lines.

"Upper" refers to the surface of the bed on which the needles lie and "downwardly" or "lower" refers to the opposite direction. Therefore, in a dial "upper" will refer to the top side and "downwardly" or "lower" will refer to the direction of the bottom side. In a cylinder, since, as has been stated, a cylinder is usually considered vertical with the needles running vertically, "upper" will refer to the surface on which the needles lie, and "downwardly" or "lower" will refer to the direction inwardly of the needles.

In order to produce, according to the preferred embodiment of the present invention, a needle bed as shown in FIGS. 1 and 2, but having special hard material in wear areas 20, there is first provided a needle bed blank which is machined according to conventional practice, except at the forward edge of the bed. Preferably, before proceeding with the steps of the invention, the needle channels are cut or milled into the upper surface of bed or blank 10, thereby producing walls 12 and channels 14. It has been previously stated that the upper surface of the forward end of the needle bed, namely, the upper surface of the wear surface, is at the same level, or on the same plane, as the channel bottoms. As a practical matter, the upper surface of the wear surface need only be at about the level of the channel bottoms. In other words, the upper surface of the wear surface can be slightly above or slightly below the channel bottoms. If it is slightly below the channel bottoms, the channel bottoms will soon wear down and then the wear surface will go into play. If the upper surface of the wear surface is slightly above the channel bottoms, this does no harm, since the machine can operate in this manner and the wear surface will serve its function. However, ideally, and this is preferred, the upper surface of the wear surface should be flush with the channel bottoms. Since the upper surface of the wear surface, as has just been stated, can be slightly above

or slightly below the channel bottoms, hereinafter the level at which the upper surface of the wear surface will lie in the final needle bed will be referred to as the "predetermined level," said predetermined level being about flush with the needle bottoms.

The upper surface of the forward edge of the bed blank 10 is then cut or milled down to a level no lower than the predetermined level of the wear surface. Preferably, as will be described hereinafter, said upper surface is cut down to a level slightly higher than said predetermined level. Then, referring to FIGS. 3A, 3B and 3C, metal is removed preferably by cutting or milling, in laterally spaced apart areas 22 at the forward edge of the bed 10, said laterally spaced areas, corresponding to the needle channels, the metal being removed to a depth below said predetermined level. For the sake of convenience, the level of the needle bottoms 19 is the predetermined level. In areas 24, said area 24 intervening spaced apart areas 22, corresponding to or aligned with, walls 12, the metal of bed 10 is not removed, thereby producing alternating areas 22 and 24, which in FIGS. 3A, 3B and 3C are grooves 22 alternating with lands 24.

In the next step, as shown in FIGS. 4A, 4B and 4C, special hard material 26 is deposited, preferably in a particulate, liquid or vapor form. This material 26 is deposited from the upper side of the bed along the entire forward edge of the bed 10 so as to occupy the recesses 22 and to cover the upper surfaces of areas 24. Sufficient of this hard material 26 is supplied so as to fill recesses 22 to a level above the predetermined level, producing the results shown in FIGS. 4A, 4B and 4C.

The upper exposed surface of the forward edge of the needle bed is then ground down to the predetermined level, as shown in FIGS. 5A, 5B and 5C. It will be apparent that, as a result of this grinding operation, the upper surface of the hard material in recesses 22 is now at the predetermined level. Since the upper surface of each intervening area or land 24 was at the predetermined level or higher than the predetermined level before the deposition of the hard material 26, the grinding step which produced FIGS. 5A, 5B and 5C removed all of the hard material 26 overlying areas 24 and exposed the base metal of the bed 10 as the upper surface of areas 24 at the predetermined level. In order to insure that all the hard material 26 is removed in areas 24 to expose the base metal, it is preferable that the upper surface of the forward edge of the blank be initially cut down to a level somewhat higher than the predetermined level. In this way the grinding operation will not only remove the hard material 26, but will also remove a layer of the base metal.

It is necessary to insure that the hard material 26 does not overlay areas 24 at this stage of the process because the hard material which is preferably used in the present invention is so hard that it cannot be removed by milling operations. It can only be removed by grinding. In the next step, longitudinal grooves 28 are cut into the forward edge of the needle bed 10, said grooves corresponding to, or aligned with, walls 12. Normally, these grooves 28 will be laterally narrower than the walls 12 and the recess 28 will normally be cut deeper or lower than the depth of recesses 22. This is shown in FIGS. 6A, 6B and 6C. Into these recesses 28 are inserted combing teeth 16. It is pointed out that combing teeth are generally made of steel harder than the needle bed, since they are also subject to appreciable wear. It is pointed out, also, that conventionally combing teeth are inserted by slotting or grooving the needle bed. The insertion of the combing teeth is shown in FIGS. 7A, 7B and 7C and the final needle bed therefore corresponds to that shown in FIG. 1, except that the wear areas 20 are now made of special hard material.

It is noted that the width of grooves 28 is less than the width of areas 24. This is done so that the material in which the grooves are cut is constituted only by the base material of the bed, since the presence of any hard material would render the milling of grooves 28 virtually impossible.

The width of areas 22 represents a matter of choice, except that the areas 22 should be sufficiently wide to provide the

adequate wear surface under the needle hooks. Preferably, the areas 22 are as wide as the needle channels 14 but most preferably, slightly wider. Therefore, intervening areas 24 should preferably be no wider than the channel walls 12 and preferably slightly narrower. In any event, grooves 28 should be narrower than areas 24.

The depth of the recesses 22 in the final needle bed is not critical, since the material 26 is so hard. There need be only as little material in the final wear surface as is necessary to provide adequate bonding in the recesses 22. It has been found that the depth of the material in the final bed can be as small as 0.001 ins., although the depth can be as great as 0.007 ins., or even greater. However, greater depths are normally not necessary and just constitute a waste of materials. The length of areas 22, that is, the distance from the forward extremity of the bed rearward, again, is not critical and it can be as small as $\frac{1}{16}$ – $\frac{1}{8}$ " or more, or less. The grooves 28 need be only sufficiently deep to hold the combing teeth and such depths are well known in the art. For example, the grooves 28 may be slots extending through the thickness of the needle bed, as shown in the drawings.

According to the invention, the hard material 26 in the embodiment which has been described, and the hard material 40 in the embodiment to be described, is preferably applied in particulate, liquid or vapor form, or in any other form which serves the same purpose. For example, it can be applied in particulate form by powder metallurgy, it can be deposited in vapor form by cathodic or vapor deposition, or it can be applied in liquid form by a melt. In all these forms materials can be applied which are hard enough to prevent excessive wear.

A preferred method of applying the hard material 26 is by a commercial process called Plasma-Plating, a process of Union Carbide. In this process the hard material is introduced in powder form into a high velocity inert gas jet at temperatures as high as 30,000° F. The powder particles are melted in the jet and are accelerated by the jet onto the surface being coated at supersonic velocity. As the projected material strikes the part being coated, a high density layer is formed upon impact, producing a microscopic weld so that the coating becomes virtually integral with the base. In other words, according to the preferred process, the hard material is applied in particulate, liquid or vapor form so that the hard material 26 becomes substantially integral with the metal of the needle bed. Various materials can be applied by the Plasma-Plating process. For example, there can be applied oxides such as chromia, alumina, titania or zirconia, carbides such as tungsten carbide or chrome carbide, refractories and ceramics, or pure metals. The preferred materials, according to the present invention, are chromia or tungsten carbide. These constitute materials so hard that they cannot be milled and can only be ground.

In the embodiment so far described, the needle bed has combing teeth. In certain machines, such as rib machines, combing teeth are unnecessary, since the needles of the two needle banks act in opposition to each other. Such a needle bed is illustrated in FIG. 8, wherein 30 shows a needle bed having needle retaining walls 32 and defining channels 34. The wear surface, instead of being applied only in spaced apart areas, as was done in the previous modification, can be provided along the entire forward edge of the bed, as shown at 36. To produce this bed there is provided a blank or bed 30 having needle channels therein, as was done in the previous modification. However, instead of, as was done in FIGS. 3A, 3B and 3C, forming recesses in spaced apart areas 22, the entire forward edge can be notched, as shown at 38, in FIGS. 9 and 10. Then the special hard material 40 is applied along the entire forward edge, completely filling recess 38. Recess 38 was originally cut below the predetermined level and sufficient material 40 is applied to fill recess 38 above the predetermined level, as shown in FIG. 11. The forward edge is then ground down, as shown in FIG. 12, to produce a wear surface 36 along the entire edge of the bed and at the predetermined level.

It will be appreciated that the hard material need not be inserted only in the areas which will ultimately end up with the hard material, since this may create problems of masking. It is much simpler to apply the hard material to areas adjacent the desired areas, such as was done in connection with areas 24. However, in any area which will ultimately not have any hard material, the height of the base at such areas should be greater than the final desired level, so that when the hard material is ground down the base material will be exposed. It is also much easier to grind down a large area, for example the entire edge of the needle bed, removing all the hard material which is not wanted, rather than only grinding small locations.

In the illustrated embodiments the needle channels were formed before providing the recesses for receiving the hard material. Although this is a preferred method, the needle channels can be formed at any stage in the process. In other words, the needle channels can be formed at any time after the shaping of the blank has begun. Areas 22 have been described as corresponding to or being aligned with the needle channels, while areas 24 have been described as corresponding to or being aligned with, the needle retaining walls. Obviously, if the needle channels are formed in the needle bed after the hard material has been deposited, the recesses 22, for example, at the time they are formed, cannot be aligned with the needle channels. Instead, to be more precise, they are aligned with the location in which the needle channels will ultimately be formed. It is for this reason that these areas and other locations have been described as "corresponding to" the elements with which they will ultimately be aligned.

The invention comprehends the method of producing the needle beds, as well as the novel beds produced thereby.

I claim

1. A method of producing a needle bed having (1) a plurality of laterally spaced apart upstanding needle retaining walls defining therebetween needle channels, (2) laterally spaced apart hard wear surfaces at a predetermined level on the upper surface of the forward edge of said bed, said laterally spaced apart surfaces being aligned with said needle channels and said predetermined level being about even with the bottoms of said needle channels, and (3) combing teeth between said hard wear surfaces and aligned with said needle retaining walls, comprising the steps of
 - a. providing a metal needle bed blank;
 - b. removing metal from the upper surface of the forward edge of said blank to a depth below said predetermined level in laterally spaced apart areas corresponding to the needle channels of the finished needle bed while leaving the metal at a height at least as high as said predetermined level in the areas intervening between said spaced apart areas and corresponding to said retaining walls, thereby forming laterally spaced apart recesses;
 - c. applying a material harder than the metal of said blank to said spaced apart recesses and portions of said forward edge adjacent thereto until said harder material has been applied in said recessed to a height above said predetermined level;
 - d. grinding all of the upper surface of said forward edge down to said predetermined level, thereby removing all of said hard material above said predetermined level in each of said spaced apart areas, and thereby removing all of said hard material from said intervening areas while removing any metal of the blank in said intervening areas above said predetermined level, to thereby produce a wear surface of said harder material in each of said spaced apart areas at said predetermined level and exposing the metal of said blank in said intervening areas at said predetermined level so that the metal of said blank in said intervening areas can be cut to provide grooves therein;
 - e. cutting a groove into the metal exposed in each intervening area corresponding to a needle retaining wall and inserting a combing tooth in each of said grooves, said combing teeth extending above said predetermined level; and,

f. at any time subsequent to step (a), forming laterally spaced apart upstanding needle retaining walls in said blank rearward of said forward edge and aligned with said intervening areas, said walls defining therebetween said needle channels, said channels being aligned with said spaced apart areas, the bottoms of said needle channels being at about said predetermined level.

2. A method according to claim 1, wherein said harder material is inserted by depositing it in particulate, liquid or vapor form so that the deposited material becomes substantially integral with the metal of the needle bed blank.

3. A method of producing a needle bed according to claim 1, wherein, in step (c) said harder material is applied along the entire edge of said blank to raise the entire edge above said predetermined level.

4. A method of producing a needle bed according to claim 24, wherein each of said spaced apart areas is at least as wide as said needle channels.

5. A method of producing a needle bed according to claim 4, wherein said needle retaining walls are formed in said blank before step (b).

6. A method of producing a needle bed according to claim 2, wherein said harder material is deposited by being projected onto the needle bed blank in a molten form at supersonic velocity.

7. A method of producing a needle bed according to claim

6, wherein said harder material is a material selected from the class consisting of chromia and tungsten carbide.

8. A method according to claim 3, wherein said harder material is inserted by depositing it in particulate, liquid or vapor form so that the deposited material becomes substantially integral with the metal of the needle bed blank.

9. A method of producing a needle bed according to claim 8, wherein said harder material is deposited by being projected onto the needle bed blank in a molten form at supersonic velocity.

10. A method of producing a needle bed according to claim 9, wherein said harder material is a material selected from the class consisting of chromia and tungsten carbide.

11. A method according to claim 5, wherein said harder material is inserted by depositing it in particulate, liquid or vapor form so that the deposited material becomes substantially integral with the metal of the needle bed blank.

12. A method of producing a needle bed according to claim 11, wherein said harder material is deposited by being projected onto the needle bed blank in a molten form at supersonic velocity.

13. A method of producing a needle bed according to claim 12, wherein said harder material is material selected from the class consisting of chromia and tungsten carbide.

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