United States Patent [19]

Shepard et al.

[11] **3,753,412**

[45] **Aug. 21, 1973**

[54] **SELECTIVELY HARDENED NEEDLES**

[75] Inventors: **Richard W. Shepard,** Torrington; **William A. Ross,** Harwinton; **Samuel Audia,** Torrington; **Gary W. Holmes,** Winsted, all of Conn.

[73] Assignee: **The Torrington Company,** Torrington, Conn.

[22] Filed: **Dec. 2, 1971**

[21] Appl. No.: **204,337**

Related U.S. Application Data

[63] Continuation of Ser. No. 44,709, June 9, 1970, abandoned.

[52] **U.S. Cl.** .... **112/222,** 28/4 N

[51] **Int. Cl.** **D05b 85/00**

[58] **Field of Search** .... 112/222; 223/102; 66/116, 118; 28/4 N; 128/335, 339, 340

[56] **References Cited**

UNITED STATES PATENTS

3,356,047 12/1967 Short .... 223/102 X

11,769 10/1854 Wilcox et al. .... 112/222 X

FOREIGN PATENTS OR APPLICATIONS

1,485,382 9/1969 Germany 112/222

Primary Examiner—Werner H. Schroeder

Attorney—F. S. Troidl et al.

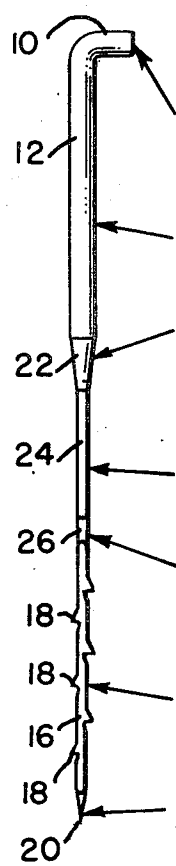
[57] **ABSTRACT**

A selectively tempered needle is disclosed. The needle comprises one section having a predetermined hardness and a second section having a different predetermined hardness. Needles of several different sections, each having different hardnesses, may be formed.

The needles are made by applying different amounts of heat to different portions of the needle. The heat may be applied electromagnetically.

An automatic system feeds each needle to a heating area where the needle is selectively tempered and straightened. The selectively heated needle is simulataneously expelled from the heating area and cooled.

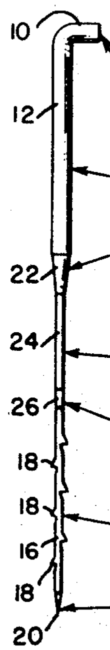
5 Claims, 8 Drawing Figures



	BROAD RANGE	PREFERRED RANGE
CRANK	40–61	43–53
SHANK	47–61	51–59
START OF INTERMEDIATE BLADE	50–61	55–61
INTERMEDIATE BLADE	54–64	58–64
START OF TRIANGULAR BLADE	53–63	57–63
TRIANGULAR BLADE	57–64	60–64
POINT	57–67	63–67

2 Sheets-Sheet 1

FIG. 2

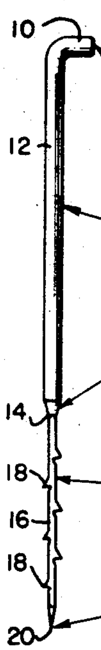


	BROAD RANGE	PREFERRED RANGE
CRANK	40-61	43-53
SHANK	47-61	51-59
START OF INTERMEDIATE BLADE	50-61	55-61
INTERMEDIATE BLADE	54-64	58-64
START OF TRIANGULAR BLADE	53-63	57-63
TRIANGULAR BLADE	57-64	60-64
POINT	57-67	63-67

	BROAD RANGE	PREFERRED RANGE
BLADE	58-63	61-63
POINT	62-67	63-65

FIG. 3

FIG. 1



	BROAD RANGE	PREFERRED RANGE
CRANK	40-61	43-53
SHANK	50-64	54-62
START OF TRIANGULAR BLADE	53-63	57-63
TRIANGULAR BLADE	57-64	60-64
POINT	57-67	63-67

	BROAD RANGE	PREFERRED RANGE
BLADE	56-62	59-62
POINT	58-66	62-66

FIG. 4

INVENTORS
RICHARD W. SHEPARD
WILLIAM A. ROSS
SAMUEL W. AUDIA
GARY W. HOLMES
BY
Frank S. Troidl
ATTORNEY

Patented Aug. 21, 1973 3,753,412

2 Sheets-Sheet 2

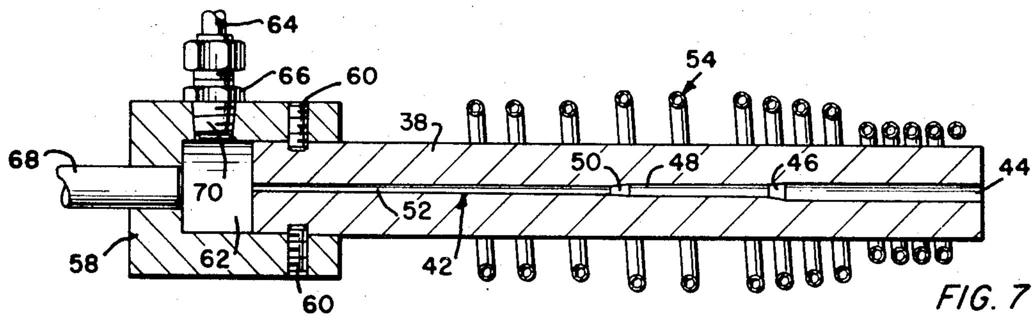


FIG. 7

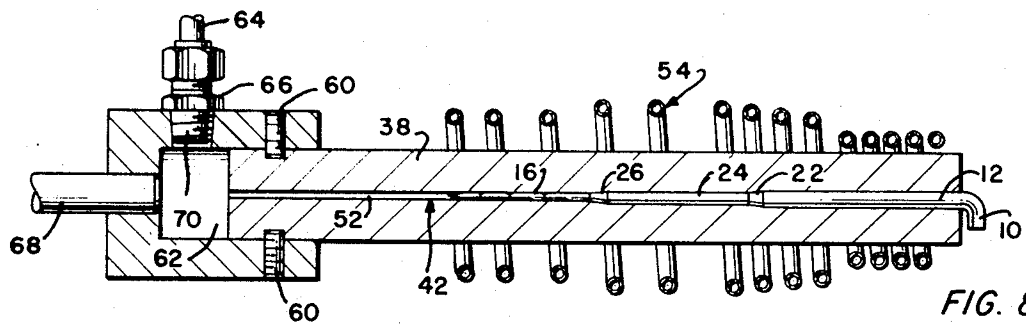


FIG. 8

FIG. 5

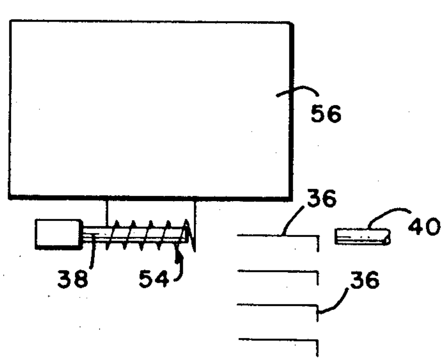
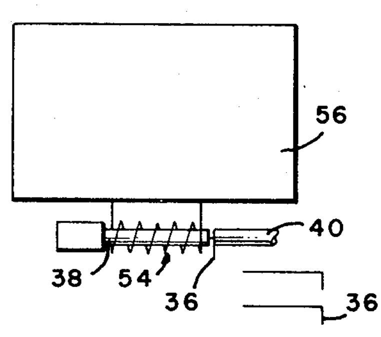


FIG. 6



INVENTORS
RICHARD W. SHEPARD
WILLIAM A. ROSS
SAMUEL W. AUDIA
GARY W. HOLMES
BY
Frank S. Troidl
ATTORNEY

SELECTIVELY HARDENED NEEDLES

This application is a continuation of application Ser. No. 44,709 filed June 9, 1970, now abandoned.

This invention relates to the tempering of metal. More particularly, this invention is a method and apparatus for selectively tempering fully hardened needles of all types and of all functions. Using this new system and method, a novel needle is made which has a plurality of different longitudinal sections each of which may have a different degree of hardness.

A current method of making a needle is to harden the needle by heating to a high temperature and then immediately cooling the needle to some significantly lower temperature resulting in high hardness. The next step is to heat the needle to a lower temperature than that used in hardening. This is called "tempering." This tempering method requires a considerable time, often hours. A slow rate of subsequent cooling is often needed as well.

In the usual tempering procedures, the part is heated for so long that conduction causes all of the part to reach the same temperature and to remain there, or soak, at that temperature. We have found that two procedures may be used to alter this. Heat may be applied unevenly to the part or heat may be conducted away unevenly from the part; or both simultaneously. If this is done at high temperature - short time conditions, there is not enough heat in the part or in the surrounding material to soak or equalize the tempering temperatures. Thus each separate portion of one part is tempered according to how much heat it is given minus how much heat it loses.

In such a manner, one portion of a part can be completely tempered or annealed, while another portion can be left fully hardened or untempered, or any intermediate stages may be attained.

As an example, a felting needle may be left untempered or slightly tempered at its point, where the wear is worst, tempered as a stiff spring at the points of maximum bending moment, and tempered much more, to a nearly annealed state near the crank, where breakage cannot be tolerated, even under severe abuse.

This invention provides the needle art with a process and system for automatically making a needle having a plurality of different longitudinal sections of different hardnesses. The entire process is performed in less than one minute for heavy gauge needles and preferably in less than one second one second for fine gauge needles. A short time is necessary to prevent old-fashioned soaking or conducting effects which eliminate the selective tempering. Thus, from 1 to 60 needles containing selectively tempered longitudinal portions may be made automatically per minute by this new system.

Briefly, the new needle comprises a first longitudinal section having a predetermined hardness and a second longitudinal section having a different predetermined hardness. The point is the hardest part of the needle. Needles having at least four other sections and at least six other sections are disclosed.

Briefly, the new process for forming the needle comprises the step of applying different amounts of heat at different longitudinal portions of the needle and then expelling and cooling the needle.

The system for making the needle may be briefly described as a fixture with a bore and a heat generating member associated with the fixture. At least a part of the bore is shaped the same as the needle and adapted to receive an inserted needle. Since the bore is shaped the same as the needle, crooked parts of the needle will be straightened when inserted in the bore. The heat generating member applies different amounts of heat at different longitudinal portions of the needle.

The invention as well as its many advantages will be further understood by reference to the following detailed description and drawings in which:

FIG. 1 is a selectively tempered felting needle with a graphical representation of preferred ranges and broad ranges of hardness for a steel with a full hardness of 67RC on the Rockwell "C" Scale;

FIG. 2 is a second embodiment of felting needle showing preferred ranges and broad ranges of hardness with the same steel as used for the needle of FIG. 1;

FIG. 3 is a sewing needle showing the preferred ranges and broad ranges of hardness at different longitudinal positions with the needle made of the same steel as the needles of the other Figures;

FIG. 4 is a tufting or carpet needle showing the preferred ranges and broad ranges of hardness also with the needle made of the same steel as the needles of the other Figures;

FIG. 5 is a schematic view showing our new process for making selectively tempered needles;

FIG. 6 is a view similar to FIG. 5 but showing schematically the positions of the parts of the system with a needle injected into the fixture for selective heating;

FIG. 7 is a side elevational view in section and on an enlarged scale showing the apparatus for selectively heating the needle, and then expelling and cooling the needle; and

FIG. 8 is a view similar to FIG. 7 but showing a needle in proper position within the bore of the fixture so that it can be selectively heated and straightened.

Referring to the drawings and more particularly to FIG. 1 wherein a felting needle is shown. The felting needle includes a crank **10** and a shank **12** which extends generally perpendicularly from the crank. A tapered portion **14** connects the shank **12** to a blade **16** having barbs **18**. The blade ends with a point **20**.

You will note from the graphical representation of the Rockwell hardness that the hardest part of the felting needle is, in general, the point **20**. Also, in general, the crank **10**, shank **12**, tapered portion **14**, and blade **16** are progressively harder.

Referring to FIG. 2, a felting needle is shown which includes the same parts as the felting needle shown in FIG. 1, and in addition includes a first tapered portion **22**, an intermediate blade **24**, and a second tapered portion **26**. Tapered portion **22** and tapered portion **26** connect the intermediate blade **24** to the shank **12** and blade **16**, respectively. The point of the felting needle of FIG. 2 as in FIG. 1 is the hardest portion of the needle. The other six sections of the needle each have a different hardness when compared with one another. The needle shown in FIG. 2 is not progressively harder as one proceeds from the crank to the point. Note for example that, in general, the intermediate blade **24** is harder than the adjacent tapered portions **22** and **26**.

FIG. 3 shows a sewing needle including a blade **28** and a point **30**. The point **30** is harder than blade **28**.

FIG. 4 shows a tufting or carpet needle including a blade **32** and a point **34**. The point **34** is harder than blade **32**.

The hardnesses shown in FIGS. 1 through 4 are given in Rockwell C Scale units. The ranges are for a steel with a full hardness of 67RC. A different steel would move the ranges up or down. Also, other hardness measuring systems could be used. Tables are available for converting the Rockwell system into various other hardness systems such as Shore, Brinell, or Vickers. Also, we show hardnesses at certain points on the needles. Actually there is a blending or gradual change between such points, not a sharp definition.

FIG. 5 and FIG. 6 are schematic representations of a system for forming our new needle. Referring to these Figures, the automatic system includes a conventional automatic feeding mechanism (not shown) for feeding a plurality of needles 36 to the proper position so that the end needle may be fed to a fixture 38 by means of a pusher 40.

As shown in FIG. 7 and FIG. 8 the fixture 38 is preferably tubular. A bore 42 extends longitudinally entirely through the fixture 38. A portion of the bore 42 is shaped the same as the needle to be selectively tempered and straightened. In the embodiment shown in FIG. 7 and FIG. 8 the bore 42 is shaped to receive, selectively temper, and straighten the felting needle shown in FIG. 2. It is to be understood, of course, that the bore would be differently shaped for differently shaped needles.

To receive the felting needle of FIG. 2 the bore 42 includes a section of larger diameter 44, a first tapered portion 46, a section of intermediate diameter 48, a second tapered portion 50, and a section of smallest diameter 52 which extends to the opposite end of the fixture 38 from the end of the fixture in which the needle is inserted. Bore portions 44, 46, 48, 50, and 52 conform in shape to the shank 12, first tapered portion 22, intermediate blade 24, second tapered portion 26, and blade 16, respectively of the felting needle.

An electromagnetic coil 54 is wound about the fixture 38. The electromagnetic coil is wound in a particular manner to provide different amounts of heat at different longitudinal portions of the needle to thereby make a needle having different longitudinal portions of different hardnesses. The coils of the electromagnetic 54 may be made of copper tubing and carry cooling water.

The electromagnetic coil 54 has its terminals connected to a source of high-frequency current 56. The current from the source 56 sets up a rapidly reversing electromagnetic field which is coupled with the needle in the fixture causing extreme magnetic excitation of the needle which becomes heated. The fixture 38 is nonmagnetic. Therefore, it is not heated and conducts away some of the heat of the needle, the amount being determined by the temperature at which the fixture is maintained.

The turns of coil 54 have various diameters and various spacings from one another in accordance with the longitudinal location of the turns on the fixture. The amount of heat applied to a particular area of the needle is a function among other things of the diameter of each turn, the spacing between the turns, the thickness of the fixture, and the thickness of the needle. In general, the closer the spacing between the turns and the smaller the diameter of each turn, the more heat is applied to the needle.

The fixture 38 is mounted on a movable fixture support 58 by means of pins 60 extending through holes in the support 58 to grooves provided in the fixture 38. A space 62 is provided in the support 58 to receive an inert gas which is fed to the space 62 by means of a flexible tube 64 attached to the support 58 by hexagonal nut 66.

The support 58 may be moved by any conventional means but is illustrated in FIGS. 7 and 8 as being connected to a rod 68 which may be pneumatically operated.

In operation, the fixture 38 is moved to a position to receive a needle 36. The pusher 40 inserts the end needle 36 from the line of needles into the fixture (see FIG. 6). The pneumatically operated rod 68 then returns the fixture with its loaded needle to the position shown in FIG. 5. A high-frequency current from the source 56 is fed through coil 54 for a preset time and at a preset amperage. Thus, the needle is heated different predetermined amounts at different predetermined longitudinal portions on the needle.

When the current from source 56 is shut-off, a cooling and expelling inert gas at a pressure of, for example, 180 psig is fed from a gas source through flexible tube 64 and against the needle to expel the needle. The entire series of steps may be performed in times under 1 second. If desired, the system may be adjusted to perform the steps in as long as 1 minute.

The same techniques may be used to stress relieve and straighten needles with minimum effect on overall hardness.

We claim:

1. An industrial machine needle made from a single material comprising:
   - a first longitudinal section having a predetermined hardness in the range 62 – 67 on the Rockwell C scale; and
   - a second longitudinal section having a different predetermined hardness in the range 58 – 63 on the Rockwell C scale, substantially adjacent to the first longitudinal section.

2. A needle comprising:
   - a blade having a pre-determined hardness in the range 56 – 62 Rc; and
   - a point which is harder than the blade and in the range 58 – 66 Rc.

3. A needle wherein the point section is in the hardness range 57 – 67 Rc and there are at least four discrete other sections, each having a different degree of predetermined hardness.

4. A needle in accordance with claim 3, wherein there are six discrete other sections.

5. An industrial machine needle made from a single material comprising:
   - at least one longitudinal section having a predetermined hardness in the range 56 – 64 on the Rockwell C scale; and
   - a point which is harder than said longitudinal section having a predetermined hardness in the range 57 – 67 Rc, the at least one longitudinal section being substantially adjacent to the point.

* * * * *