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MANUFACTURE OF NEEDLES AND NEEDLE-LIKE ARTICLES

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Fig. 1.

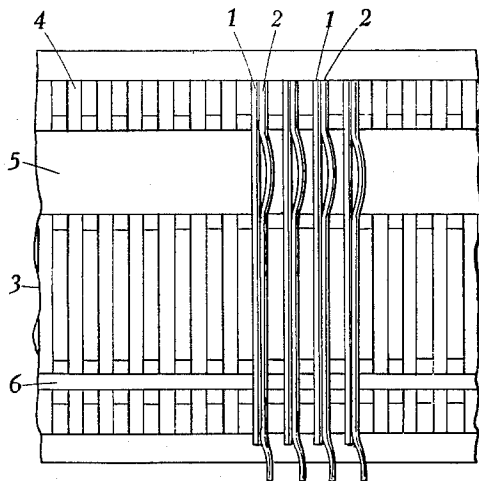


Fig. 2.

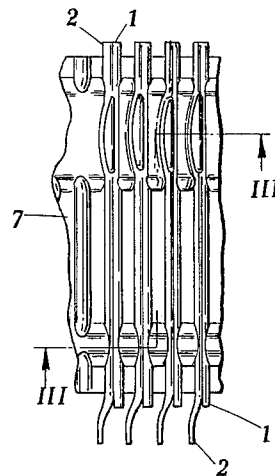
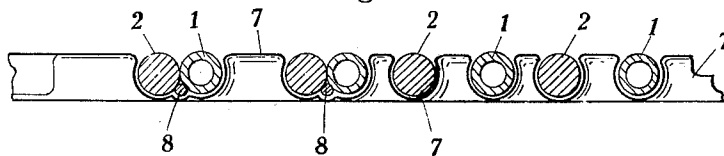


Fig. 3.



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## UNITED STATES PATENT OFFICE

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## MANUFACTURE OF NEEDLES AND NEEDLE-LIKE ARTICLES

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3 Claims. (Cl. 113—112)

This invention relates to the manufacture of needles or needle-like articles which are necessarily or conveniently made up or "fabricated" from more than one part, being devices of accurate shape or intricate construction which are assembled from two or more small parts and which are required to possess one or more of the properties of high spring temper, strength, hardness and resistance to wear.

The invention is thus appropriate for the manufacture of needles, sinkers and the like for machine knitting, hypodermic needles, and certain types of surgical needles built up for special purposes.

According to the invention, a process for the manufacture of such needles and needle-like articles comprises assembling two or more parts of a needle or the like in a jig, such parts including a part or parts of work-hardened precipitation-hardening alloy which hardens below 590° C., hard-soldering the parts together at a temperature below 650° C. whilst held in the jig, and subjecting the article to heat treatment in which the temperature is first raised at a comparatively slow rate to a value not exceeding 590° C. and is then reduced at about the same rate from that value substantially without maintenance at such value. The jig may be made of a destructible or soluble material and removed from the article either before or after the heat treatment by being broken or dissolved away from the article.

The article may consist solely of parts of a non-ferrous precipitation-hardening alloy or may include a part or parts of nitrogen-hardened or hardenable alloy.

One application of the invention will now be described by way of example and with reference to the accompanying drawing, in which:

Fig. 1 is a plan view of a matrix for the assembly of parts of a needle to which the invention is applied,

Fig. 2 a plan view from below of the needle parts held in a metal-foil jig, and

Fig. 3 is a cross-section to a larger scale on the line III—III in Fig. 2.

The said application of the invention will be explained by reference to the manufacture of machine-knitting needles. The figures illustrate a special needle whose form and manner of operation constitute no part of the present invention. It will accordingly be sufficient to state that the needle consists of a body 1 and a part 2 from whose end portion the hook of the needle is to be produced. In this instance, both components 1, 2 of the needle are made of the alloy

known by the registered trade-mark "K" Monel," that is a nickel alloy whose principal constituents may have approximately the following proportions: 63% Ni, 30% Cu, 3.5% Al, 1.5% Fe and no more than about 0.2% C. These components are produced with work hardening which leaves them a hardness of preferably, at least 250 Brinell.

The components 1, 2 are assembled in a matrix 3 which, as illustrated in Fig. 1 may be designed to receive several needle assemblies side by side. The matrix comprises a flat metal block with a series of grooves 4 for receiving the needle components and two channels 5, 6 deeper than and running at right angles to the grooves. These grooves permit of a jig being engaged with the needle assemblies whilst they lie in the grooves 4 in the matrix.

The jig employed must be capable of gripping the components and holding them together, it must be capable of withstanding the melting temperature of the hard solder used and it must be readily removable from the complete assembly. Preferably it consists of a piece of ductile metal foil 7 which can be pressed round the components 1—2 where left free in the channels 5, 6 for example by rolling the foil with a rubber roller. Fig. 3 illustrates, in somewhat idealised fashion, how the foil engages around the components at these points. The foil should have the properties, first, that it possesses a higher melting temperature than the hard solder and, secondly, that the said solder does not adhere strongly to it. A suitable metal foil is aluminium foil of, say,  $\frac{1}{1000}$ " thick. Aluminium, apart from the fact that the solder does not "take" upon it at all, has the advantage that it heats up quickly and stands up well to the soldering temperature. Use may also be made of iron foil coated with an anti-flux material such as thick oxidising graphite or chromic oxide. Alternatively, the jig may be made of a composition, such as brick dust and plaster of Paris which can be pressed or run into the channels in a plastic state. A suitable composition comprises 40 parts of plaster of Paris and 60 parts of brick dust. Use may also be made of moulding sand, for example moulding sand prepared for use with a small proportion of flour. Finally, jigs moulded from heat resistant cement or even from glass may be employed, depending upon the requirements in each particular case.

As illustrated, the solder is applied in the form of a thin wire 8 (Fig. 3), of about one quarter the diameter of the components 1, 2. It may,

however, be applied in the form of powder or small strips. In any case the solder is secured in position together with the components by the jig 7. The solder employed should be a hard solder with a comparatively low melting point, preferably about 600° C. and not exceeding 650° C., as otherwise a high degree of hardness of the components 1, 2 and spring temper cannot be obtained.

The soldering is effected by heating the components 1, 2, held together by the jig 7, to the appropriate temperature, namely 620-630° C. for the solder mentioned. This temperature preferably does not exceed 640° C. and should not exceed 650° C. in any case.

Next the soldered needle-like article is subjected to heat treatment comprising heating it to a temperature between 500° C. and 590° C. at a comparatively slow rate, preferably a rate of 100° C. per hour. The maximum temperature should in any case not exceed 590° C. Such a high maximum temperature can be avoided if the parts have been subjected to considerable cold working and the soldering has been effected at a low temperature.

The article should not be maintained at 590° C. for any length of time nor should the subsequent cooling be too slow, as otherwise the solder may be damaged. Preferably, upon attainment of 590° C., cooling is commenced immediately and continued at about the same rate as the heating, preferably 100° C. per hour, down to, say, 350° C. The article is finally cooled in air. The heat treatment is most conveniently performed in a salt bath, but may be carried out in an electric furnace with forced draught.

The jig 7 may be removed, either before or after the heat treatment. Generally the jig may be broken away. In some cases, however, it may be convenient or necessary to remove a part or the whole of the jig by dissolving it away from the needle. In the case of a jig made of aluminium foil, for example, caustic potash may be used as solvent. Obviously the solvent selected in any particular case must not attack either the parts of the article or the solder. Thus iron foil used as a jig for parts of the non-ferrous alloy only may be dissolved in hydrochloric acid. In the case of a jig made of a non-metallic composition, this may be broken away from the needle assembly.

The resultant needle has a spring temper comparable to that of carbon steel and is comparatively stainless with a Brinell hardness of about 300 or over.

For some purposes it may be desired to include in a needle or needle-like article one or more parts of very great hardness and/or wear resistance. In this case such parts may be made of a nitrogen-hardened or hardenable alloy such as a steel alloy containing, for example, 1.4-1.7% Cr and, generally, 0.9-1.2% Al together with some molybdenum. These parts, for example latch parts and bearing or cam surfaces to be attached to a knitting-needle body of "K Monel," are incorporated in the article by the above described soldering process, after being assembled in the matrix and secured in position by the jig. The parts are preferably already in a hardened condition, since heat treatment for hardening purposes is liable to weaken the soldered joint. However, if the parts are in a soft condition, it will be necessary to harden them by normal nitriding treatment applied to the complete needle or article.

Nitriding for three hours gives a depth of case of about .0015" to .002" which will be suitable for the parts of many kinds of needles. In other cases, however, where the sections of the parts are only a few thousandths of an inch thick, a shorter nitriding period, say one hour, may be sufficient. If the nitriding is performed upon the complete needle, it will be necessary to leave the needle in the jig, during the said nitriding, particularly if much thickness of case is required.

The added parts will have an extremely high degree of hardness, up to so-called diamond hardness of 1100 Brinell, and high resistance to wear and corrosion.

In the case of a latch to be included in a needle in the above-described fashion, aluminium foil may be pressed over the bearing surfaces and into the hole in the latch in which the rivet is inserted. Also the foil may be pressed round the rivet. Then, when the soldering is effected, the latch will not be soldered to the rivet or bearing surfaces. The aluminium can be removed by dissolving it in caustic potash.

For the purposes of the invention other non-ferrous alloys possessing precipitation-hardening properties may be used, for example other nickel alloys. Also other alloys capable of taking a high degree of hardness by a nitriding process may be employed.

I claim:

1. A process for the manufacture of needles and needle-like articles, comprising producing a plurality of small parts, one of which is composed of a work-hardened precipitation-hardening alloy which hardens below 590° C., securing said plurality of small parts in a jig in close relation to one another, with the said one part still in its cold-worked condition, hard soldering said plurality of parts by heating them, held together in the jig at a temperature below 650° C., and subjecting the article produced by the soldering to heat treatment by bringing the temperature at a rate of about 100° C. per hour to a value not exceeding 590° C. and then reducing it at about the same rate from that value substantially without maintenance at such value.

2. A process for the manufacture of needles and needle-like articles, comprising producing a plurality of small and relatively elongate and narrow parts, one of which is composed of a work-hardened precipitation-hardening alloy which hardens below 590° C., securing said plurality of small and relatively elongate and narrow parts in close relation alongside each other in a jig in a groove of a matrix, with the said one part still in its cold-worked condition, applying solder along between said parts, hard soldering said plurality of parts by heating them, held together in the jig, at a temperature below 650° C., subjecting the article produced by the soldering to heat treatment by bringing the temperature at a rate of about 100° C. per hour to a value not exceeding 590° C. and then reducing it at about the same rate from that value substantially without maintenance at such value, and removing said article from the matrix and the jig.

3. A process for the manufacture of needles and needle-like articles, comprising producing a plurality of small and relatively elongate and narrow parts, one of which is composed of a work-hardened precipitation-hardening alloy which hardens below 590° C., producing a small associated member to be attached to such parts, securing the plurality of small and relatively elongate and narrow parts in close relation along-

side each other and in association with said member in a metal foil jig in a groove of a matrix, with the said one part still in its cold-worked condition and the foil pressed into contact with surfaces of said parts and member required to be kept free of solder, applying solder along between said parts, hard soldering said plurality of parts by heating them, held together in the jig, at a temperature below 650° C., heat treating the

5 article produced by the soldering by bringing its temperature at a rate of about 100° C. per hour to a value not exceeding 590° C. and then reducing the temperature at about the same rate from that value substantially without maintenance at such value, and removing said article from the matrix and foil.

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