Jan. 28, 1941. J. MORTON ET AL 2,229,929

KNITTING ELEMENTS OF KNITTING MACHINERY

Filed Oct. 15, 1937 2 Sheets-Sheet 1

Fig. 1.

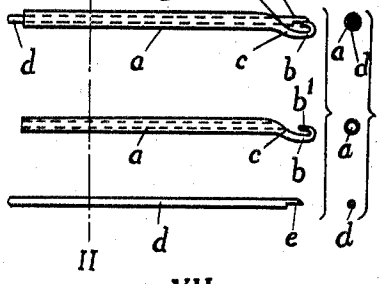


Fig. 2.

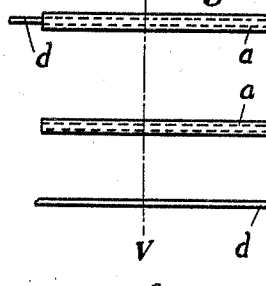


Fig. 4.

Fig. 5.

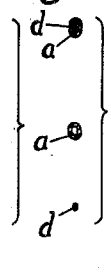


Fig. 6.

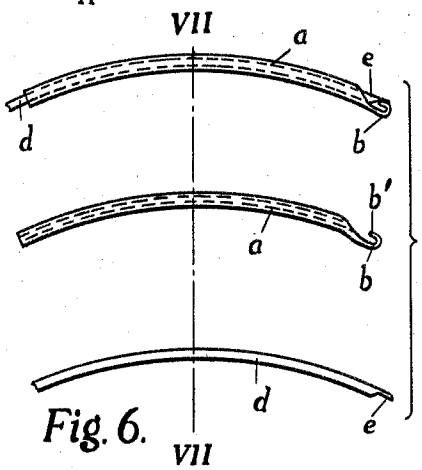


Fig. 7.

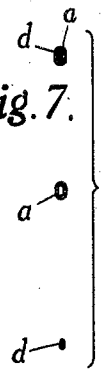


Fig. 3.

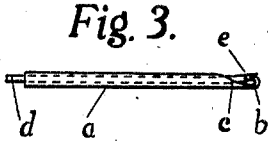


Fig. 8.

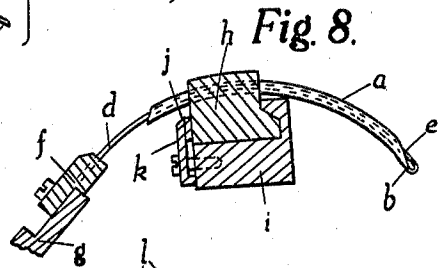


Fig. 9.

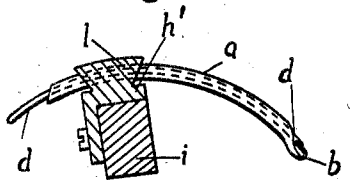


Fig. 10.

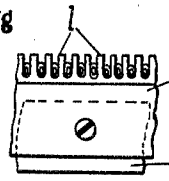


Fig. 11.

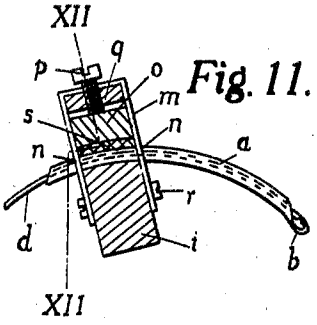
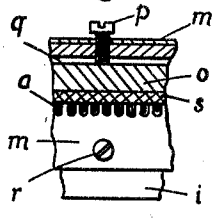


Fig. 12.



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KNITTING ELEMENTS OF KNITTING MACHINERY

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Fig. 13.

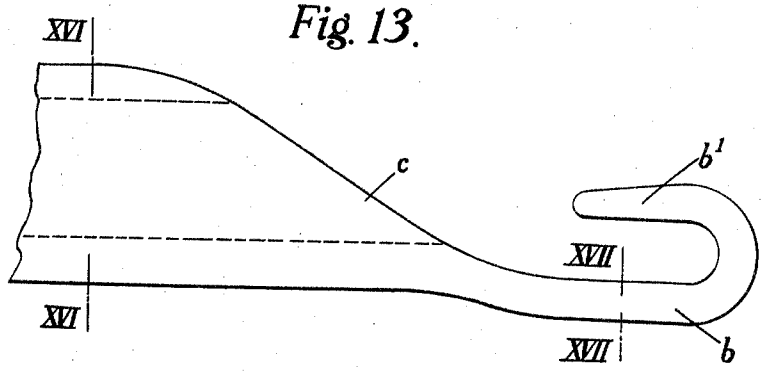

Fig. 14.

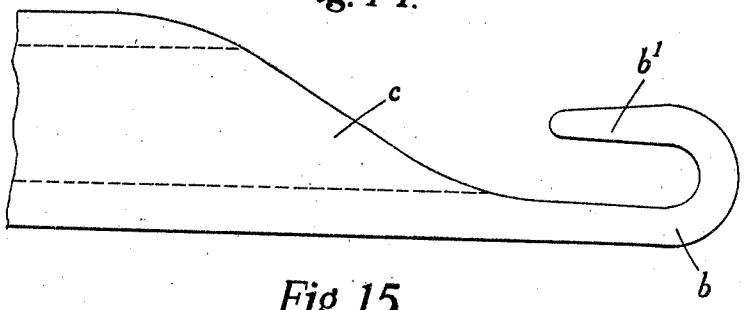

Fig. 15.

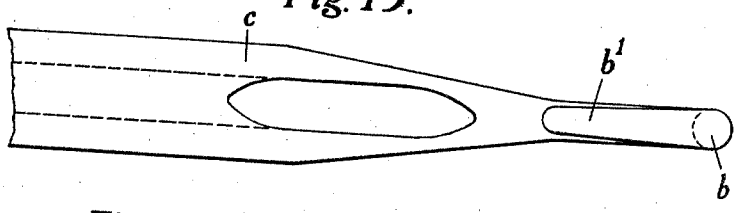

Fig. 16.

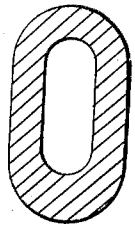

Fig. 17.

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UNITED STATES PATENT OFFICE

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KNITTING ELEMENTS OF KNITTING MACHINERY

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Application October 15, 1937, Serial No. 169,306
In Great Britain February 19, 1937

13 Claims. (Cl. 66—120)

This invention relates to knitting needles and associated parts, for use in knitting machines, and to methods of making such needles. The invention is particularly applicable to warp knitting machines, but not exclusively associated with this kind of knitting machine.

Knitting needles for knitting machines have been made in which a stem or shank of channel or U-shaped cross section is formed at one end with a bevelled, cam portion merging into a hook. This kind of needle is arranged to operate in association with a shim or tongue lying in the channelled shank and arranged to undergo to-and-fro motion relatively to the needle, by virtue of movements of both needle and tongue. In this to-and-fro motion, the tip of the tongue alternately overlaps and moves away from the tip of the hook so as periodically to form with the latter a closed loop. When a knitted stitch has been formed on the hook, the tongue is withdrawn into the channel while the needle is moved forward so as, by the cam action of the bevelled portion, to lift the knitted stitch to a position such that the tongue, in closing the hook, will pass through the stitch. Prior to the closing of the hook, the thread is lapped on the hook once more for the formation of a new stitch; then, when the hook has been closed, the previously formed stitch is cast off.

These channelled needles have been formed by a cutting operation, in which a solid steel wire is slotted to provide the channelled stem or shank, the tip of the wire being swaged and bent to form the hook. An alternative method is to take a flat metal blank and fold or press it to shape. In both cases, the channelled needle member has to be carefully hardened and tempered, the hardening being such as to enable the needle to stand up to the work that it has to do in acting on threads, and the tempering being such that the needle can be bent slightly, when in the machine, so as to bring it into alinement with the other needles. It has been found that, when it is attempted to make fine gauge needles in this manner, they are apt to be distorted during the hardening treatment. Moreover, difficulty has been experienced in shaping fine gauge needles with adequate accuracy, the channels having been found not always to be of uniform depth nor to be located centrally. Further, these needles are very expensive to manufacture.

In the production of fine knitted work, it is essential for the needles to be formed accurately and positioned accurately in the knitting machine. The slightest irregularity will lead to the production of defective fabric and may cause breakage of the needle, or of its associated tongue, or of one of the other knitting elements in the machine such as a warp guide or a sinker.

It has hitherto been generally considered in the knitting machine industry that the bearded type of needle is most suitable for fine work as these needles can be arranged very close together, say, 40 needles per inch. Bearded needles, however, are not suited for very high speed operation, that is to say, for knitting as much as a thousand rows of stitches per minute. This is due to the nature of the bearded needle which is such that it must undergo irregular motion which differs substantially from simple harmonic motion and includes periods of dwell. This disadvantage, however, is not inherent in the aforementioned needles, co-operating with separate tongues, which will operate satisfactorily if moved with simple harmonic motion or a motion closely approaching simple harmonic motion. The tongues can also be moved with simple harmonic motion. The needles and tongues, therefore, can be operated through the medium of simple eccentrics, and there is nothing to prevent almost any desired speed of operation being attained, provided the inertia forces are kept reasonably low. Although these compound needles have the advantage over bearded needles that they can be operated at higher speeds, they have hitherto had the disadvantage, previously indicated, of requiring to be spaced more widely apart so that they have not been suited to the manufacture of very fine fabrics.

The invention aims at providing compound needles, i. e., needles comprising a hooked needle and a separate tongue, made of such fine gauge and in such better and cheaper manner than heretofore that they can readily be used for the production of fine work and in machines designed to run at a high speed.

One object of the invention consists in a knitting needle, for use in a knitting machine, comprising a tubular metal piece as used in the manufacture of hypodermic needles and formed at one end with a hook. In the manufacture of such a needle, a piece of tubing of the desired length, wall thickness and internal diameter is selected as a blank, and this blank is then bevelled at one end and the tip of the bevelled portion is formed into the necessary hook. The hooked part may be slightly set back so that the bevelled portion can more readily lift the knitted loops prior to their casting off. After being prop-

erly shaped, the tubular needle may be carefully hardened, tempered and finally polished.

The tubing is made of a strong and tough metal such as a high carbon or stainless steel, and it has been found after repeated trials and experiments that tubing of the nature and dimensions used in the manufacture of hypodermic needles may be employed with very satisfactory results.

Another object of the invention consists in an assembly, for use in a warp knitting machine, comprising a tubular metal element, as used in the manufacture of hypodermic needles, formed at one end with a hook, and a second tubular metal element, also as used in the manufacture of hypodermic needles, and capable of sliding in said first-mentioned element alternately into and out of overlapping engagement with the tip of said hook. In the manufacture of the inner tubular element, a piece of very fine tube of the correct length, wall thickness and external diameter is selected as a blank and is carefully shaped to conform to the shape of the passage within the needle. The external diameter of the inner element or tongue is such that it can slide smoothly within the tubular needle.

A further object of the invention consists in an assembly, for use in a knitting machine, comprising a tubular metal element, as used in the manufacture of hypodermic needles, formed at one end with a hook, and a wire element arranged to slide within the tubular element alternately towards and away from the tip of said hook. Naturally, the wire is of such thickness that it can slide smoothly in the tubular needle element. The wire may be formed at one end with a lip which registers with and overlaps the tip of the needle hook. In the case of very fine gauge needles having an internal wire tongue, the latter need not be specially shaped at the end which engages the tip of the needle hook.

Knitting needles in accordance with the invention may be either straight or arcuate when viewed in elevation, and in the case of arcuate needles, the tubular blanks from which these are formed can be bent or pressed to shape while containing a mandrel or core.

Yet another object of the invention consists in a knitting needle, for use in a knitting machine, comprising a tubular metal piece as used in the manufacture of hypodermic needles, said piece being formed at one end with a hook and being flattened at each side so that it has an ellipse-like cross section with its major axis in the plane of the hook. The flattening may be performed in a press, while the needle contains a mandrel or core of the desired form, so that the cross section of the shank becomes oval or comprises flat sides joined by semi-circular parts. In the case of these needles having flattened shanks, the tongues used in association therewith are formed with a corresponding cross section. This flattened formation may be adopted where the needles have to be very closely pitched, and yet are required to react comparatively rigidly to the pull of the thread.

To ensure smoothness of operation, the internal passages in the needles or the external surfaces of the tongues, or both, may be coated with cadmium. The needles may be treated internally with a flash of cadmium and the tongues may be cadmium plated. The tongues, since they are well guided by the tubular needles, may be made of any reasonably strong metal which slides well in the metal of which the needles are made. Alternatively, the tubular needles may be provided each with a lining enabling the employment of a tongue of a metal not freely slidable in the unlined tubular needles. The tongues may usefully be made of steel, phospher-bronze, or other wire.

More particularly defined, the invention consists in a fine gauge compound needle assembly, for use in a knitting machine, comprising the combination of a needle member formed from a blank of metallic tubing, as used in the manufacture of hypodermic needles, including a beveled end projection terminating in a pin bent into hook formation, and a tongue member adapted to slide to and fro in the metallic tubing alternately into and out of engagement with the tip of said hook.

The invention further comprises the elements and combinations of parts set forth in the annexed claims.

In order that the invention may be clearly understood and readily carried into effect, some constructions in accordance therewith will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows views of a straight tubular needle and a tongue associated with the needle;

Figure 2 shows cross sections on the line II—II in Figure 1;

Figure 3 shows another form of straight needle with its associated tongue;

Figure 4 shows views of a flattened tubular straight needle and a tongue associated with that needle;

Figure 5 shows cross sections on the line V—V in Figure 4;

Figure 6 shows views of a curved and flattened needle and a tongue associated with that needle;

Figure 7 shows cross sections on the line VII—VII in Figure 6;

Figure 8 shows a supporting arrangement for curved needles and their tongues;

Figures 9 and 10 show a cross section and a front view of a further supporting arrangement for curved needles;

Figures 11 and 12 show respectively a cross section and a sectional elevation on the line XII—XII in Figure 11 of a further supporting arrangement for curved needles;

Figures 13 and 14 are side elevations of the hook ends of needles as shown in the preceding figures;

Figure 15 is a plan serving equally as a plan of the end in Figure 13 and of that in Figure 14; and

Figures 16 and 17 are cross sections on the lines XVI—XVI and XVII—XVII in Figure 13 (similar cross sections on Figure 14 would be the same as Figures 16 and 17).

Referring to Figures 1 to 7, which show the needles and tongues to a somewhat enlarged scale, it will be seen that the needles *a* comprise tubular shanks formed at their ends with hooks *b*. The tubular shanks have bevelled or tapered portions *c* which merge into the hooks *b*, the latter comprising tips *b'* joined by arcuate portions to intermediate portions extending from the bevelled portions *c*. In Figures 1 to 3, the tubular shanks are of circular cross section and the tongues *d*, which are also of circular cross section, are freely slidable in the tubular shanks. In Figures 4 to 7, the shanks are flattened so that they have a somewhat elliptical or oval cross section, the tongues in these figures having a corresponding cross section. In Figures 1, 2, 3, 6 and 7, the tongues *d* are wires, that is to say, they have

solid cross sections, but in Figures 4 and 5 the tongue *d* is tubular, being cut from tubing as used in the manufacture of hypodermic needles. The precise form of the needle hooks can be seen from Figures 13 to 17 which are drawn to a scale that is substantially fifty times full size.

In the course of the manufacture of any one of the needle members shown in the figures, a small tubular blank, as used in the manufacture of hypodermic needles, is swaged so as to provide the bevelled or tapering portion *c*, and the tip of the bevelled or tapering portion is formed into a pin of thin, solid cross section, which is bent over to provide the hook *b*. The bore for the tongue, shown in dotted lines in the figures, extends from the hook end of the shank to the opposite end, the bore being open at both ends for the passage of the tongue *d*. In the needles shown in Figures 1, 4 and 6, the hook is offset or set back so that the tip *b'* of the hook lies substantially in alinement with the bore through the shank and so that the tip of the tongue can engage the tip of the hook to provide with the hook a closed loop over which a knitted stitch can be cast off. In the needle of Figure 3 the hook is not offset but is bent on a smaller radius and is of such dimensions that it lies within the ambit of an imaginary cylinder extending from and having the same cross sectional dimensions as the external surface of the tubular shank. In each case the operative end of the tongue *d* is bevelled or tapered off so as to provide a tip which overlies the tip of the hook, when the latter is closed, to provide a smooth surface over which the knitted stitch is cast off.

In the case of the tubular tongue *d* in Figures 4 and 5, the tip of the needle enters the bore through the tongue so that the tip of the hook is covered by or enveloped by the end of the tongue which is supported by the hook. An advantage of this arrangement is that the bevelled or cam portion *c* can be reduced in length without increasing the slope of the upper surface of this portion, thereby permitting a smaller relative movement of the needle and tongue, or alternatively the portion *c* can be reduced in height without increasing its length. This will be appreciated when it is remembered that the upper surface of the bevelled portion *c* acts as a cam in the forward motion of the needle to lift a stitch from the hook on to the shank of the needle so that the tongue *d* can pass through the stitch.

The needle members *a* can be secured side by side parallel to each other to supporting sections *h* at their ends opposite the hooks, and the tongues can be likewise secured to sections *f*, see Figure 8. The sections *h* and *f* are secured side by side to long bars *i* and *g*. The bars *i* and *g* may be independently operated and receive differential to-and-fro motions in precisely timed relationship from mechanism such, for example, as eccentric-and-strap mechanism. Alternatively, as only a small relative movement is necessary, the tongues may be held stationary, so that, in operation, the needles may be moved relatively to the tongues, in which case the cloth may be given a motion in timed relationship by means of sinkers.

When the needles are required to work in a curved path, they can be made arcuate, as shown in Figures 6 to 12, about the axis of curvature of their path, one convenient arrangement being such that the needle and tongue members are both oscillated about the same axis. Where the needles are required to work in a straight path, or even a curved path, they can be made straight, as shown in Figures 1 to 5, and in that event the members may receive either a reciprocatory motion in a straight path or an oscillatory motion in an arcuate path.

In Figure 8 the supports *h* may be lead castings which securely hold the tubular needles *a* and are held removably in place in the carrier bar *i* by means of a clamping plate *k* and screws with felt or leather cushioning at *j*. The tongues are simply embedded as usual in the metal or other sections *f*.

In the arrangement in Figures 9 and 10, the needles *a* are mounted in metal sections h^1 screwed to the carrier bar *i*, the sections being formed with tricks *l* between which the needles are placed and secured by soldering or metal spraying.

In Figures 11 and 12, the needles *a* are secured to the needle bar *i* by means of clamping plates *m* made with slots *n* at each side through which the needles can pass as shown at Figure 11 and are held securely in position by means of a soft metal or other cushion *s* capable of being pressed down on the needles by means of a plate *o* acted on by a screw *p* passing through a plate *q* embraced by the clamps *m*. The clamps are removably fastened to the needle bar by screws *r*. In this arrangement broken needles can be readily removed and replaced. The top of the needle bar is made straight or arcuate to suit straight or curved needles. In the case of needles of circular cross section, the holes *n* would of course be round instead of in the form of slots.

It has been found that it is possible by this invention, to make satisfactory needles from metal tubing of the following cross sectional dimensions:

Needle shank of circular cross section

	Inch
External diameter of original tube	.025
Diameter of bore	.0125

Needle shank of ellipse-like cross section

	Inch
Lesser external cross sectional dimension of tube	.018
Greater external cross sectional dimension of tube	.03
Thickness of tube wall	.00625
Tongue for ellipse-like tubular needle may have lateral thickness of	.005

It is to be understood that the foregoing dimensions are given simply by way of example of what can be done.

Tubes having an external diameter as small as .01 inch can be made and used for the needles.

Arcuate needles of ellipse-like cross section have been made of stainless steel tubing as follows:

	Inch
Lesser external cross sectional dimension of tube	.0175
Greater external cross sectional dimension of tube	.035
Thickness of tube wall	.005
Lateral thickness of stainless steel, cadmium plated tongue for this tube	.007

It has been found possible with compound needles made in accordance with this invention to pitch them as close as 38 to the inch in warp knitting machines.

It will be apparent that needles such as hereinbefore described make it practicable to perform finer gauge knitting than heretofore re-

garded as attainable with compound needles both as to the number of looping stitches to the inch laterally and the number of courses knitted per inch longitudinally. The tongue being enclosed in the needle, the height of the needle need not be greater than its lateral width, and consequently the loop is not expanded or distorted when drawn over the shank of the needle.

It will also be apparent that, since the manufacture of fine tubes of the kind from which the needle and tongue members can be made is already carried out industrially, the requisite supply of such tubes can be obtained comparatively cheaply and the cost of the needles is therefore considerably reduced. These tubes may be made by any of the methods of making hypodermic needles, as by rolling, swaging, or drawing, a tubular billet on a mandrel or core composed of metal capable of extreme elongation and retention of tensile strength, and pulling sections of the worked tube off the core after dividing the worked tube, but not the core, into lengths equal to the lengths of the tubes required. If desired, the tubes may be provided during their manufacture with an internal lining of a metal different from the metal of which the tubes are composed. This may be effected by inserting a tube of the lining metal between the billet and the core, the lining tube and outer tube being intimately bound together during the working of the assembly with the assistance, if necessary, of an intervening layer of flux or solder and suitable heat treatment.

In some cases it is advantageous to form the bore somewhat eccentrically within the tube, the thickest part of the wall being that on which the hook is formed by the swaging operation, as shown in Figs. 13 and 16.

We claim:

1. A knitting needle for use in a knitting machine, comprising a fine metal tube as used in the manufacture of hypodermic needles and formed at one end with a hook having its tip substantially in alinement with the axis of the passage through the tube.

2. A knitting needle for use in a warp knitting machine, comprising a tubular metal element as used in the manufacture of hypodermic needles and formed at one end with a hook including a tip portion substantially in alinement with the axis of the element, an intermediate portion substantially parallel with said axis and spaced therefrom at a greater radial distance than the external surface of said tubular element, an arcuate portion joining said tip portion and said intermediate portion, and a tapered portion joining said tubular element and said intermediate portion, the latter and said arcuate and tip portions having a relatively small cross section.

3. A knitting needle for use in a warp knitting machine, comprising a tubular metal element as used in the manufacture of hypodermic needles and formed at one end with a hook including a tip portion substantially in alinement with the axis of the element, an intermediate portion parallel with said axis and spaced therefrom at a distance equal to that of one wall of said tubular element, said intermediate portion merging into said tubular element, and an arcuate portion joining said tip portion and said intermediate portion, the latter and said arcuate and tip portions having a relatively small cross section.

4. A knitting needle for use in a knitting machine, comprising a fine metal tube as used in the manufacture of hypodermic needles, said tube being formed at one end with a hook and being flattened at each side so that it is of substantially elliptical cross section, the major axis of the said cross section being in the plane containing the hook, and the tip of the latter being substantially in alignment with the axis of the passage through the tube.

5. An assembly for use in a warp knitting machine, comprising a tubular metal element, as used in the manufacture of hypodermic needles, formed at one end with a hook, and a second tubular metal element, also as used in the manufacture of hypodermic needles, which is a sliding fit in said first mentioned element so as to be accurately guided thereby while being moved alternately to cover and uncover the tip of said hook.

6. A fine gauge compound needle assembly for use in a knitting machine, comprising the combination of a needle member formed from a blank metallic tubing, as used in the manufacture of hypodermic needles, and including a tapering end projection terminating in a pin bent into hook formation, and a tongue member adapted to slide to and fro in the metallic tubing so as alternately to overlap and move away from the tip of said hook, said tongue member being a sliding fit in said metallic tubing so as to be constrained thereby in all directions transversely to the tongue.

7. For use in a warp knitting machine, the combination of a fine gauge metal tube, as used in the manufacture of hypodermic needles, formed at one end with a hook and a second metal tube, also as used in the manufacture of hypodermic needles, arranged to slide within said first-mentioned tube while opening and closing said hook, said two tubes being flattened laterally so that they both have ellipse-like cross sections with a common major axis contained in the plane of the hook.

8. For use in a warp knitting machine, an assembly comprising a tubular metal piece, as used in the manufacture of hypodermic needles, formed at one end with a hook and flattened laterally so that it has an ellipse-like cross section with its major axis in the plane of the hook, and a flat metal wire, which is a neat sliding fit within said tubular piece so as to be guided accurately therein while opening and closing said hook.

9. For use in a warp knitting machine, the combination of a tubular metal element, as used in the manufacture of hypodermic needles, formed at one end with a hook and a second tubular element, also as used in the manufacture of hypodermic needles, which is a neat sliding fit within said first-mentioned tubular element and having its end disposed to fit over the end of said hook so as to be supported thereby.

10. A knitting needle for use in a knitting machine comprising a fine metal tube formed with an eccentrically disposed passage and having at one end a hook which merges into said tube at the thickets part of the wall thereof.

11. A knitting needle for use in a knitting machine comprising a fine metal tube formed with an eccentrically disposed passage and having at one end a hook lying in a plane bisecting at right angles the thickest part of the wall of said tube, the hook merging into that part of the wall.

12. A knitting needle for use in a knitting machine comprising a fine metal tube flattened at each side, so that it is of substantially elliptical cross section, and formed with a passage so disposed that one of the parts of the wall joining

the flattened sides is thicker than the other such part, said tube having at one end a hook merging into said thicker part of the wall and lying in a plane containing the major axis of said cross section.

13. A knitting needle for use in a knitting machine comprising a fine tubular metal element formed with an eccentrically disposed passage and formed at one end with a hook including a tip portion substantially in alinement with the axis of said passage, an intermediate portion substantially parallel with said axis and spaced therefrom at a greater radial distance than the external surface of said tubular element at the thickest part of the wall thereof, an arcuate portion joining said tip portion and said intermediate portion, and a trough-shaped tapered portion joining said tubular element and said intermediate portion, the base of said trough-shaped portion merging into the thickest part of the wall of said tubular element.

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