Nov. 2, 1954 E. W. SLINGSBY 2,693,095

CIRCULAR KNITTING NEEDLE AND METHOD OF MAKING

Filed June 10, 1950 2 Sheets-Sheet 1

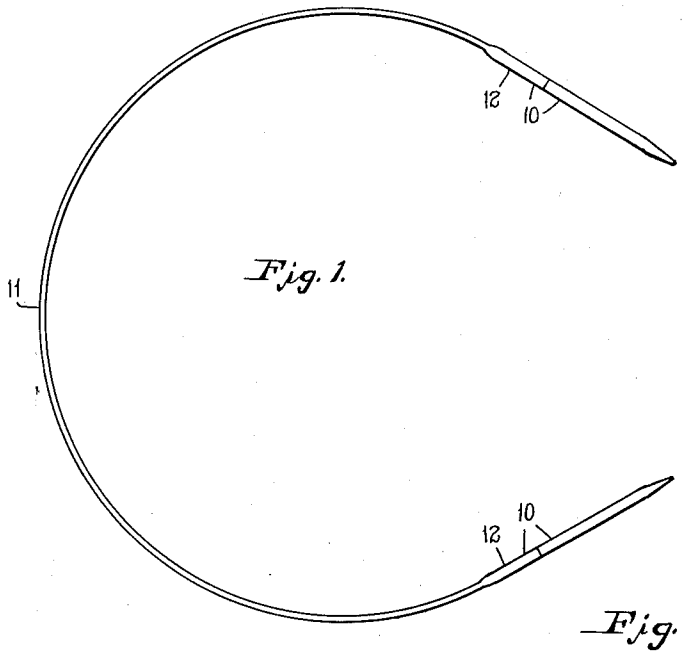


Fig. 1.

Fig. 2.

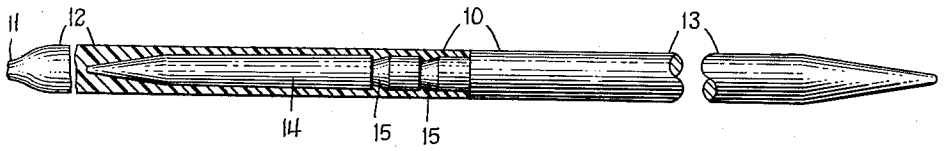
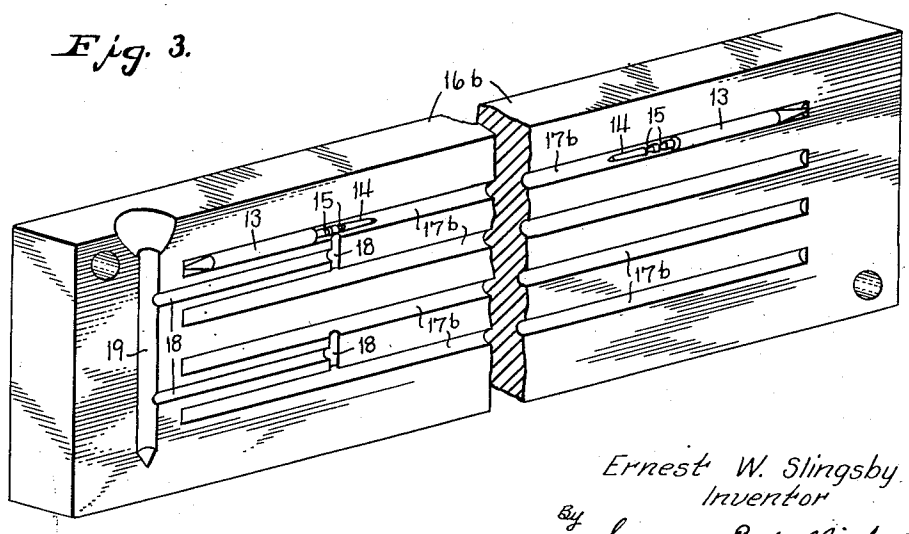


Fig. 3.



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Fig. 4.

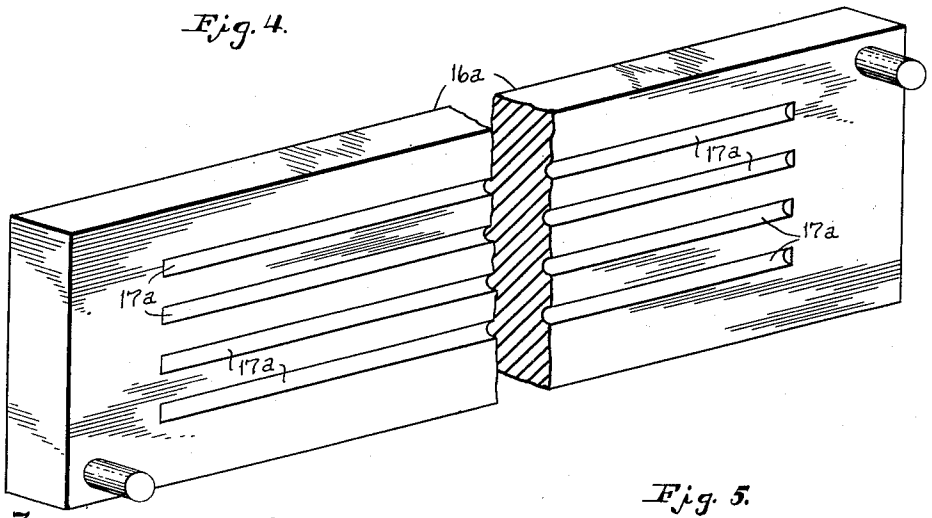


Fig. 5.

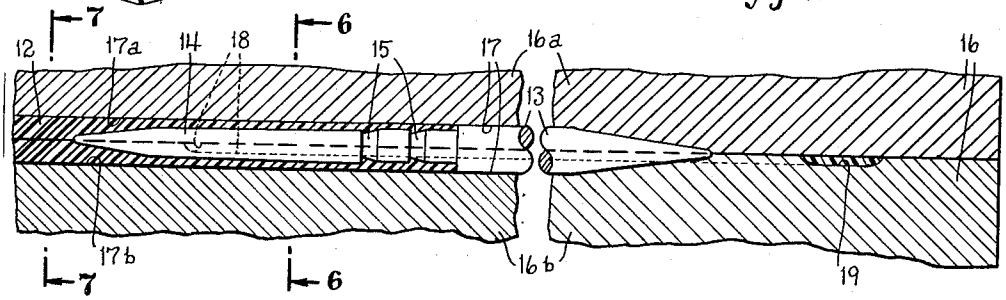


Fig. 6.

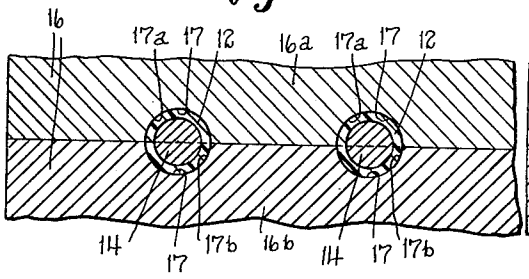


Fig. 7.

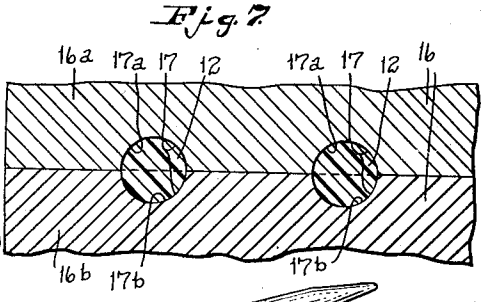
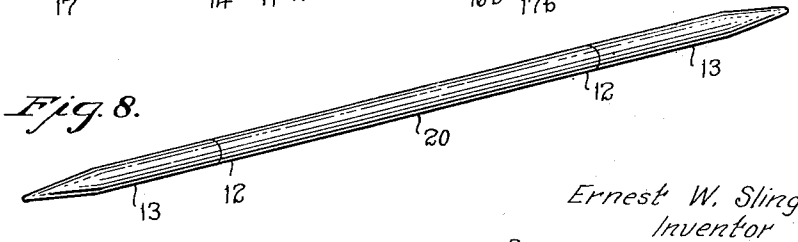


Fig. 8.



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2,693,095

CIRCULAR KNITTING NEEDLE AND METHOD OF MAKING

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Application June 10, 1950, Serial No. 167,331

6 Claims. (Cl. 66—117)

The present invention relates in general to knitting needles and more particularly to the type of knitting needles known to the trade as "circular" knitting needles, in that needles of this type are flexible so that they may be bent by the user into circular or substantially-circular form when in use. Circular knitting needles of this type are formed of a thermoplastic synthetic resin, the knitting needle of this invention being characterized by superior terminal-heads at opposite ends thereof which constitute an improvement over the circular knitting needle shown and described in the co-pending application of Hamilton C. Bates, Jr. and Ernest W. Slingsby, Serial No. 143,426, filed February 10, 1950, now abandoned.

An object of the present invention is to provide a circular knitting needle formed of a thermoplastic synthetic resin and provided with superior terminal-heads at opposite ends thereof respectively.

A further object of the invention is to provide a circular knitting needle of the type described having terminal-tips joined to the opposite ends thereof by superior substantially-integral fastening-means.

A still further object of the invention is to provide a circular knitting needle of the type described having terminal-head portions at opposite ends thereof to which metal terminal-tips are integrally secured by superior fastening-means.

A still further object of the invention is to provide a superior method for producing circular knitting needles of thermoplastic synthetic resin having terminal-heads molded in situ at opposite ends respectively of the knitting needle.

A still further object of the invention is to provide a superior method of producing circular knitting needles of thermoplastic synthetic resin wherein the molded rod from which the knitting needle is formed, is produced by introducing a thermoplastic synthetic resin into the rod-molding cavity of a mold at a point therein other than opposite that portion of the molded rod which is to be stretched, whereby upon stretching the molded rod, substantially all molecules of that portion which is stretched will be oriented in the direction of its length.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a plan view of a circular knitting needle embodying the superior terminal-ends of this invention;

Fig. 2 is an enlarged broken elevation partly in section of one end of the circular knitting needle of Fig. 1, showing details of the superior terminal-head thereof;

Fig. 3 is a perspective view of the bottom part of a two-part mold for forming the molded rods from which the needles are produced, with a terminal-tip shown mounted in opposite ends respectively of one of the mold-cavities;

Fig. 4 is a perspective view of the top part of the two-part mold for forming the molded rods;

Fig. 5 is an enlarged fragmentary side elevation in section of the assembled parts of the mold through one of the mold-cavities, showing a terminal-tip and a portion of the terminal-head portion of a molded rod therein;

Fig. 6 is an end view in section of the assembled mold on line 6—6 of Fig. 5;

Fig. 7 is an end view in section of the assembled mold on line 7—7 of Fig. 5; and

Fig. 8 is a perspective view of a molded rod produced in the mold prior to elongation for effecting a reduction in and orientation of the molecules of the portion of the rod intermediate its opposite ends.

Article

As illustrated in Figs. 1 and 2, the circular knitting needle comprises a pair of substantially-identical relatively-rigid linear terminal-heads indicated in general by the reference characters 10—10 respectively, and integrally connected by means of a relatively-slender and relatively-flexible connecting-reach 11 which is of substantially-uniform diameter throughout its length, the diameter of each terminal-head being somewhat greater than the diameter of the connecting-reach 11. By way of example, the terminal-heads 10—10 may be about ⅛" in diameter, while the said connecting-reach 11 may be about 1/16" in diameter. It is to be understood, however, that circular knitting needles will, as is customary, have a wide variety of dimensions to meet the exigencies of knitting. In general, the outer extremity of each terminal-head 10 of the circular knitting needle is tapered, as indicated especially well in Fig. 2, to provide each terminal-head with a smooth point.

The circular knitting needle above described may be formed of a wide variety of synthetic resins or combinations thereof of the well recognized "high polymer" or "super polymer" type. By way of example, nylon (polyamide), Orlon (polyacrylate or acrylonitrile), Terelene (polyester of ethylene glycol terephthalate), and saran (vinylidine chloride), are adapted for present purposes, either singly or in various combinations.

As described in the co-pending application referred to above, the knitting needle is preferably formed from a molded rod, the diameter of which is substantially uniform throughout its length, the connecting-reach 11 of the circular knitting needle being produced by subjecting the molded rod to a stretching operation, whereby the molecules in that portion of the rod intermediate its terminal-head portions 12—12 and corresponding to the connecting-reach 11 of the needle are oriented in a direction lengthwise thereof, thereby imparting the desired flexibility to the reach of the needle. Since the terminal-head portions 12—12 of the knitting needle are unstretched, the molecules therein are randomly oriented, and hence the terminal-head portions remain substantially rigid.

The present invention is concerned primarily with the superior terminal-heads 10—10 at opposite ends respectively of the flexible reach 11 of the circular knitting needle and, in this regard, each terminal-head portion 12 of the reach 11 is provided at its outer end with a terminal-tip 13. Each terminal-tip 13 is preferably a solid-metal element tapered at its outer end to provide a smooth point, and provided at its opposite end with a pointed tenon 14 of reduced diameter. In this connection, it will be noted that the over-all diameter of each terminal-tip corresponds substantially to the over-all diameter of the corresponding terminal-head portion 12 of the knitting needle, and that the tenon 14 of each terminal-tip is embedded in the end of its respective terminal-head portion of the knitting needle.

In order that the joint formed between the end of each terminal-head portion of the needle and the tenon of the corresponding terminal-tip may be strong and substantially permanent, each tenon is provided with a plurality of grooves, serrations or other surface irregularities 15 to roughen its outer surface, the end of each terminal-head portion 12 of the circular knitting needle being molded around the roughened tenon of the corresponding terminal-tip to form, in effect, a substantially-integral joint therewith, as and in the manner hereinafter described.

Method

The circular knitting needles, including the superior terminal-heads 10—10 of this invention, are formed from rods of substantially-uniform diameter produced in a single molding operation which, as indicated in Figs. 3 through 7, utilizes a two-part mold indicated generally at

16 having a plurality of rod-forming mold-cavities indicated generally at 17 connected by sprues 18 to a common gate 19. As a characteristic feature of the present invention, each pair of rod-molding cavities 17 of the mold is connected to a common sprue which, in turn, intersects each mold-cavity adjacent that portion thereof which corresponds to the terminal-head portion of a molded rod. In the embodiment shown, each sprue intersects one end only of a mold-cavity and substantially opposite the tenon of the terminal-tip mounted therein, but it is within the purview of the invention to introduce a sprue-aperture into either or both ends of a mold-cavity or at any other point or points thereof other than opposite that portion of the molded rod which is to be stretched.

As in conventional two-part molds, the top part or cope 16*a* and bottom part or drag 16*b* are formed with complementary rod-forming cavities 17*a* and 17*b* respectively, the sprues 18 and gate 19 being formed in the drag only of the mold. It will be clear, therefore, that when the cope and drag of the mold are assembled as in Figs. 5, 6 and 7, and the thermoplastic synthetic resin is injected into the rod-forming mold-cavities 17 by way of the sprues 18 and gate 19, the resin flows, in the present instance, into one end only of each rod-forming mold-cavity 17 and from thence longitudinally thereof to its opposite end. Thus, that portion of each molded rod which is intermediate its terminal-head portion is formed by thermoplastic synthetic resin, wherein the direction of flow of resin is substantially continuous and in one direction, that is to say, the molecular dispersion of the resin in the portion of the rod intermediate its ends is substantially uniform and undisturbed.

In carrying out the method of this invention, the terminal-heads 10—10 of a knitting needle are formed currently with the molding of a thermoplastic synthetic resin rod from which the knitting needle is subsequently formed, as hereinafter described. Thus, in preparing a mold for forming a plurality of synthetic resin rods, a corresponding number of terminal-tips 13 is mounted in opposite ends respectively of the complementary mold-cavities 17*b* of the mold-drag 16*b*, as indicated in Fig. 3, whereupon the cope 16*a* of the mold is brought down over the drag to close the complementary mold-cavities and the sprue and gate-passages, the individual terminal-tips being gripped firmly between the walls of the mold-cavities. Thereupon, a thermoplastic synthetic resin in a substantially-fluid state is injected into the gate 19 of the mold and flows therefrom through the sprues 18 into the individual mold-cavities 17, the resin entering each mold-cavity from one end thereof adjacent that portion which corresponds to its terminal-head portion and in which a terminal-tip 13 is mounted. As shown especially well in Fig. 3, the flow of resin into each mold-cavity 17 takes place substantially opposite the tenon 14 of the adjacent terminal-tip 13, but as pointed out above, the resin may be injected into each mold-cavity at any point or points opposite the terminal-head portions of the molded rod which correspond to the portions of the molded rod which are not to be stretched. Thus, as the synthetic resin flows into and fills each mold-cavity 17, the resin is molded about the surface-roughened tenons 14 of the respective terminal-tips thereof. Thereafter, upon completion of the injection operation, the molds are cooled, whereupon the synthetic resin which forms the terminal-head portions of each molded rod shrinks around the corresponding tenon 14 of its respective terminal-tip, to grip the surface-roughened tenon firmly and form a substantially-integral joint therewith, after which the two-part mold may be separated and the rods of molded plastic material, including their integral terminal-tips, removed from the mold-cavities thereof, each molded rod 20 having the shape and appearance shown in Fig. 8. The final step in forming each circular knitting needle from a corresponding molded rod 20 is effected by gripping the terminal-head portions of each molded rod and stretching each rod longitudinally, in the manner described more fully in the co-pending application hereinabove identified, so as to attenuate the portion of each rod intermediate its terminal-head portions 12—12, which attenuated portion is referred to as the reach 11 of the knitting needle. It is a characteristic of the thermoplastic synthetic resin from which the needles are formed that on stretching the molded rods longitudinally, the intermediate portion of the rod will be reduced in cross section substantially uniformly throughout its length. Moreover, the uniform elongation of the intermediate portion of the rod serves to orient the molecules thereof substantially uniformly in the direction of elongation of the rod, whereby the intermediate portion or reach of the elongated rod is characterized by great flexibility and strength. On the other hand, the random orientation of the molecules in the terminal-head portions of the needle renders these enlarged ends of the needle relatively rigid.

Although highly satisfactory circular knitting needles may be formed by elongated molded synthetic resin rods of substantially-uniform diameter, it is also within the purview of the invention to form the circular knitting needles from rods which are molded with the portions intermediate their terminal-head portions of reduced diameter. The molded rods so formed are then subjected to a stretching operation, in the manner hereinabove described, to further attenuate the intermediate- or reach-portion of the rods, to impart the desired flexibility thereto and orientation of the molecules.

As will be apparent from the foregoing, the circular knitting needle of the present invention is characterized by having relatively-large diametered and relatively-rigid terminal-heads substantially integral with and united by a relatively-slender and flexible connecting-reach, the terminal-heads of the latter comprising metal tips which are joined thereto by tenons molded in situ in opposite ends respectively of the reach. Although the terminal-tips may be formed of metal, it is within the purview of the invention to form the tenoned terminal-tips of bone, wood, or other materials having an equivalent stiffness and rigidity.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. In a method of making a circular knitting needle having a flexible thermoplastic synthetic resin reach and terminal-head portions at opposite ends thereof, the steps of: forming a rod by injecting molten thermoplastic synthetic resin into a rod-molding cavity adjacent an end thereof which corresponds substantially to a terminal-head portion of the rod being molded so that at least the intermediate rod length between said head portions is formed by uni-directionally flowing resin and the dispersion of the resin in said intermediate rod length is substantially uniform throughout; and thereafter longitudinally stretching and accordingly cross-sectionally constricting said rod length to form said flexible reach wherein the molecules throughout the entire length of the reach are oriented in the direction of its length so that said reach has considerable flexibility and strength, while leaving the molecular orientation of the terminal-head portions substantially unaltered.

2. In a method of making a circular knitting needle having a flexible thermoplastic synthetic resin reach and terminal-heads at opposite ends thereof, the steps of placing terminal-tips in opposite ends respectively of a rod-molding cavity; forming a rod by injecting molten thermoplastic synthetic resin into the cavity adjacent one of said terminal-tips, thereby also joining said tips substantially integrally to the opposite ends respectively of the rod being molded, and forming at least the rod length to be formed into said reach by uni-directionally flowing resin so that the dispersion of the resin therein is substantially uniform throughout; and thereafter longitudinally stretching and accordingly cross-sectionally constricting said rod length to form said reach wherein the molecules throughout the entire length of said reach are oriented in the direction of its length so that said reach is characterized by considerable flexibility and strength.

3. In a method of making a circular knitting needle having a flexible thermoplastic synthetic resin reach and terminal-tips at opposite ends thereof, the steps of placing tenoned terminal-tips in opposite ends respectively of a rod-molding cavity so that the tenons face each other therein; forming a rod by injecting molten thermoplastic synthetic resin into the cavity at a place therein other than along that portion of the rod being molded which is to be formed into said reach, thereby also molding the opposite ends of the rod being formed around the tenons

of said tips and accordingly joining the latter substantially integrally to the opposite ends respectively of the molded rod, and forming at least said rod portion by uni-directionally flowing resin so that the dispersion of the resin therein is substantially uniform throughout; and then longitudinally stretching and accordingly cross-sectionally constricting said rod portion to form said reach wherein the molecules throughout the entire length of the reach are oriented in the direction of its length so that said reach is characterized by considerable flexibility and strength.

4. In a method of making a circular knitting needle having a flexible thermoplastic synthetic resin reach and terminal-tips at opposite ends thereof, the steps of placing tenoned terminal-tips in opposite ends respectively of a rod-molding cavity; so that the tenons face each other therein; forming a rod by injecting molten thermoplastic synthetic resin into the cavity within the confines of one of said terminal-tips, thereby also molding the opposite ends of the rod being formed around the tenons of said tips and accordingly joining the latter substantially integrally to the opposite ends respectively of the molded rod, and forming at least the rod portion to be formed into said reach by uni-directionally flowing resin so that the dispersion of the resin therein is substantially uniform throughout; and then longitudinally stretching and accordingly cross-sectionally constricting said rod portion to form said reach wherein the molecules throughout the entire length of said reach are oriented in the direction of its length so that said reach is characterized by considerable flexibility and strength.

5. A circular knitting needle, comprising a molded rod of thermoplastic synthetic resin capable of molecular orientation upon elongation, said rod having opposite terminal ends and an intermediate connecting reach which is permanently cross-sectionally reduced by elongation so as to be stronger than a similarly cross-sectionally dimensioned, but non-elongated, molded reach of the same resin, and terminal tips having portions, respectively, molded in said terminal ends, respectively, of said rod, said terminal tips extending longitudinally of said rod.

6. A circular knitting needle, comprising a molded rod of thermoplastic synthetic resin capable of molecular orientation upon elongation, said rod having opposite terminal ends and an intermediate connecting reach which is permanently cross-sectionally reduced by elongation so as to be stronger than a similarly cross-sectionally dimensioned, but non-elongated, molded reach of the same resin, and terminal tips having tenons, respectively, molded in said terminal ends, respectively, of said rods, said terminal tips extending coaxially of said rod.

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