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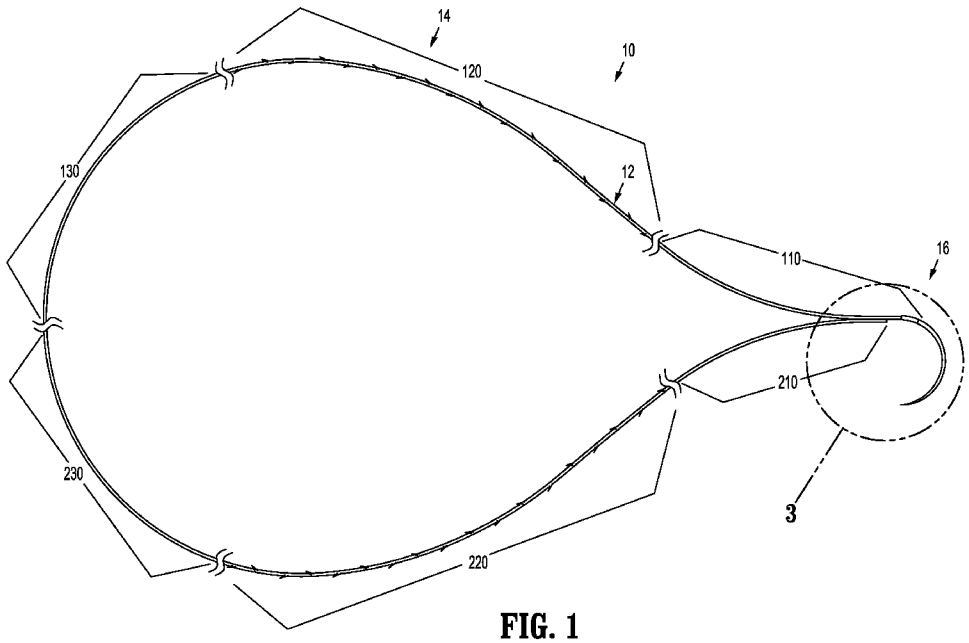

FIG. 1

(57) Abstract: A looped suture device includes a length of suture thread including a first proximal portion including a first free end, a second proximal portion including a second free end, a first intermediate portion extending from the first proximal portion, a second intermediate portion extending from the second proximal portion, a first distal portion extending from the first intermediate portion, and a second distal portion extending between the second intermediate portion and the first distal portion. The second proximal portion is secured to the first proximal portion at a joined section to form a loop. A surgical needle is secured to the first free end of the length of suture thread. The loop includes a length of at least six inches. A distance between the joined section and the surgical needle is less than one inch

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LOOPED SUTURE DEVICES AND METHODS OF FORMING LOOPED SUTURE DEVICES

FIELD

[0001] The present disclosure relates to looped suture devices. More particularly, the present disclosure relates to improved looped suture devices and methods of forming improved looped suture devices.

BACKGROUND

[0002] Looped suture devices include a loop of a length of suture thread and an attached surgical needle. Known looped suture devices are constructed by forming a loop in a length of suture thread and inserting both ends of the length of suture thread into an opening in an end of a surgical needle. To maintain the loop in the length of suture thread and to secure the length of suture thread to the surgical needle, the end of the surgical needle receiving the ends of the length of suture thread is swaged to frictionally engage the ends of the length of suture thread and retain the ends of the length of suture thread within the opening of the surgical needle receiving the ends of the length of suture thread. This technique of forming looped suture devices necessitates a large diameter surgical needle to accommodate both ends of the length of the suture thread and relies on the surgical needle to maintain the loop in the length of suture thread.

[0003] It would be beneficial to have a looped suture device having an attached surgical needle with a reduced diameter. It would also be beneficial to have looped suture devices that includes a suture loop independent of the surgical needle.

SUMMARY

[0004] A looped suture device includes a length of suture thread having a first proximal portion with a first free end, a second proximal portion with a second free end, a first intermediate portion extending from the first proximal portion, a second intermediate portion extending from the second proximal portion, a first distal portion extending from the first intermediate portion, and a second distal portion extending between the second intermediate portion and the first distal portion. The second proximal portion is secured to the first proximal portion at a joined section to form a loop.

The looped suture device also includes a surgical needle secured to the first free end of the length of suture thread. The loop includes a length of at least six inches.

[0005] In certain aspects of the disclosure, a distance between the joined section and the surgical needle is less than one inch. The surgical needle may be curved and includes an inner surface. The second free end may align with the curved inner surface of the surgical needle.

[0006] In some aspects of the disclosure, each of the first and second intermediate sections include barbs. The barbs may extend away from the surgical needle. The first and second intermediate sections may be the same length.

[0007] In other aspects of the disclosure, the second free end may engage the surgical needle. The joined section may include a welded portion. The second free end may include a tapered surface.

[0008] A looped suture device includes a length of suture thread having a first proximal portion with a first free end, a second proximal portion with a second free end, a first intermediate portion extending from the first proximal portion, a second intermediate portion extending from the second proximal portion, a first distal portion extending from the first intermediate portion, and a second distal portion extending between the second intermediate portion and the first distal portion. The second proximal portion is secured to the first proximal portion at a joined section to form a loop. The looped suture device also includes a surgical needle secured to the first free end of the length of suture thread. A distance between the joined section and the surgical needle is less than one inch.

[0009] In certain aspects of the disclosure, the surgical needle is curved and includes an inner surface. The second free end may align with the curved inner surface of the surgical needle.

[0010] In some aspects of the disclosure, each of the first and second intermediate sections include barbs. The barbs may extend away from the surgical needle. The first and second intermediate sections may include the same length.

[0011] In other aspects of the disclosure, the second free end may engage the surgical needle. The joined section may include a welded portion. The second free end may include a tapered surface.

[0012] A method of forming a looped suture device includes forming a suture loop in a length of suture thread by securing a first free end of the length of suture thread to a portion of the length of suture thread spaced from a second free end of the length of suture thread to form a joined section. The method further includes securing a surgical needle to the second free end of the length of suture thread within an inch of the joined section.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate aspects of the disclosure and, together with a general description of the disclosure given above, and the detailed description of the aspects described below, serve to explain the principles of the disclosure, wherein:

[0014] FIG. 1 is a side, perspective view of a looped suture device according to an aspect of the disclosure;

[0015] FIG. 2 is a side, perspective view of a length of suture thread of the looped suture device shown in FIG. 1 prior to forming the length of suture thread into a suture loop;

[0016] FIG. 3 is an enlarged view of the indicated area of detail shown in FIG. 1;

[0017] FIG. 4 is a cross-sectional view taken along section line 4-4 shown in FIG. 3;

[0018] FIG. 5 is a side, perspective view of a step in a suture loop forming process including first and second proximal sections of the length of suture thread received within a welding assembly;

[0019] FIG. 6 is a cross-sectional view taken along section line 6-6 shown in FIG. 5;

[0020] FIG. 7 is cross-sectional end view of the first and second proximal sections of the length of suture thread and welding assembly shown in FIG. 5, with the welding assembly in an initial position;

[0021] FIG. 8 is the cross-sectional end view shown in FIG. 7 with the welding assembly in a second, approximated position;

[0022] FIG. 9 is a side, perspective view of a step in a needle attaching process including a free end of the first proximal section of the length of suture thread received within an end of a

surgical needle of the looped suture device shown in FIG. 1 and the end of the surgical needle received within a swaging assembly; and

[0023] FIG. 10 is a side, perspective view of a step in a tapered end forming process including a free end of the second proximal section and a knife assembly.

DETAILED DESCRIPTION

[0024] Aspects of the disclosed looped suture devices and method of forming looped suture devices will now be described in detail with reference to the drawings in which like reference numerals designate identical or corresponding elements in each of the several views. As is common in the art, the term "proximal" refers to that part or component closer to the user, e.g., surgeon or clinician, while the term "distal" refers to that part or component farther away from the user.

[0025] FIG. 1 illustrates a looped suture device 10 including a length of suture thread 12 in the form of a suture loop 14, and a surgical needle 16 attached to the suture loop 14. The length of suture thread 12 may be formed of any suitable suture material. The suture material may be absorbable, non-absorbable, or a combination of absorbable and non-absorbable. The suture material may be coated or partially coated by, impregnated with, and/or include a core of one or more substances which accelerate or beneficially modify the healing process and/or the characteristics of the suture thread. In certain aspects of the disclosure, these substances include antimicrobial agents. For a non-exhaustive list of suture materials and substances which may be added thereto, please refer to U.S. Pat. No. 10,016,196.

[0026] The suture material forming the length of suture thread 12 of the looped suture device 10 may have diameter of any size. In certain aspects of the disclosure, the suture thread includes a large diameter size 1 or 0, although suture threads having diameters of other sizes are suitable for use with the aspects of the disclosure.

[0027] The surgical needle 16 of the looped suture device 10 may include any commercially available surgical needle configured to be secured to a single strand of suture thread. Although shown as being curved, the aspects of the disclosure may be suitable for use with linear surgical needles and needles of other configurations.

[0028] The length of suture thread 12 forming the suture loop 14 of the looped suture device 10 includes a first proximal section 110, a second proximal section 210, a first intermediate section 120, a second intermediate section 220, a first distal section 130, and a second distal section 230. As will be described in further detail below, the surgical needle 16 is secured to the first proximal section 110 of the length of suture thread 12. The first intermediate section 120 of the length of suture thread 12 extends from the first proximal section 110 of the length of suture thread 12. The first distal section 130 of the length of suture thread 12 extends from the first intermediate section 120 of the length of suture thread 12. The second distal section 230 of the length of suture thread 12 extends from the first distal section 130 of the length of suture thread 12. The second intermediate section 220 of the length of suture thread 12 extends from the second distal section 230 of the length of suture thread 12. The second proximal section 210 of the length of suture thread 12 extends from the second intermediate section 220 of the length of suture thread 12. The second proximal section 210 is secured to the first proximal section 110 of the length of suture thread 12 at a weld section 140 (FIG. 3) to form the suture loop 14.

[0029] In certain aspects of the disclosure, the length of suture thread 12 may measure between six inches (6") and ninety-six inches (96"). As such, when the length of suture thread 12 is formed into the suture loop 14, the suture loop 14 may include a length of between three inches (3") and forty-eight inches (48"). Although longer and shorter suture loop lengths are envisioned.

[0030] FIG. 2 illustrates the length of suture thread 12 of the looped suture device 10 prior to being formed into the suture loop 14 (FIG. 1). The first proximal section 110 and the second proximal section 210 of the length of suture thread 12 include no barbs, i.e., are barbless. The first intermediate sections 120 of the length of suture thread 12 includes first barbs 122, i.e., is barbed, and the second intermediate section 220 of the length of suture thread 12 includes second barbs 222, i.e., is barbed. The first distal section 130 and the second distal section 230 of the length of suture thread 12 include no barbs, i.e., are barbless. Although shown including first and second barbs 122, 222, respectively, it is noted that the aspects of the disclosure are equally applicable to a looped suture device with no barbs formed on either or both of a first intermediate section 120 and a second intermediate section 130 of the length of suture thread 12. Similarly, the aspects of the disclosure are equally applicable to a looped suture device with barbs formed on either or both

of the first proximal section 110 and the second proximal section 210 and/or either or both of the first distal section 130 and the second distal section 230.

[0031] The first proximal section 110 of the length of suture thread 12 includes a first free end 112 and the second proximal section 210 of the suture thread 12 includes a second free end 212. As will be described in further detail below, the second free end 212 of the second proximal section 210 may include a tapered surface 212a (FIG. 3). The length of the first proximal section 110 of the length of suture thread 12 is longer than the length of the second proximal section 210 of the length of suture thread 12. The first proximal section 110 includes a first weld portion 114. The first weld portion 114 of the first proximal section 110 is spaced from the first free end 112 and extends towards the first intermediate section 120 of the length of suture thread 12. The second proximal section 210 of the length of suture thread 12 includes a second weld portion 214. The second weld portion 214 extends from the second free end 212 towards the second intermediate section 220 of the length of suture thread 12. The increased length of the first proximal section 110 of the length of suture thread 12 and the spacing of the first weld portion 114 away from the first free end 112 of the first proximal section 110 accommodate the joining of the first proximal section 110 of the length of suture thread 12 to the second proximal section 210 of the length of suture thread 12 to form the suture loop 14 (FIG. 1) and permits attachment of the surgical needle 16 (FIG. 1) to the suture loop 14.

[0032] The first intermediate section 120 of the length of suture thread 12 and the second intermediate section 220 of the length of suture thread 12 are shown as having the same or similar lengths. It is envisioned that the length of the first intermediate section 120 of the length of suture thread 12 and the length the second intermediate section 220 of the length of suture thread 12 may be different.

[0033] The first barbs 122 on the first intermediate section 120 of the length of suture thread 12 extend in a first direction, away from the first proximal section 110, as indicated by arrow "A". The second barbs 222 on the second intermediate section 220 of the length of suture thread 12 extend in a second direction, away from the second proximal section 210, as indicated by arrow "B". As such, the first barbs 122 on the first intermediate section 120 extend towards the second barbs 222 on the second intermediate section 220 and the second barbs 222 on the second intermediate section 220 extend towards the first barbs 122 on the first intermediate section 120.

When the length of suture thread 12 is formed into the suture loop 14 (FIG. 1), the first barbs 122 on the first intermediate section 120 and the second barbs 222 on the second intermediate section 220 extend distally, i.e., away from the surgical needle 16. The direction of the first and second barbs 122, 222 on the respective first and second intermediate sections 120, 220 facilitate passage of the looped suture device 10 through tissue.

[0034] The configuration of the first and second barbs 122, 222 on the respective first and second intermediate sections 120, 220 of the length of suture thread 12 may be configured for various uses. As is known in the art, the configuration of the first barbs 122 and the second barbs 222 may include various cut depths and/or angles, include multiple angle cuts, include various longitudinal spacing, include various radial spacing, etc. The size and configuration of the individual barbs may also vary. The configuration of the first barbs 122 may be the same or different from the configuration of the second barbs 222. It is envisioned that the first barbs 122 may be positioned so as not to interfere with the second barbs 222 and the second barbs 222 may be positioned so as not to interfere with the first barbs 122 when the looped suture device 10 (FIG. 1) is received in tissue.

[0035] Although not shown, it is envisioned that the length of suture thread 12 may include a pledget "P" or other structure formed from or supported on the length of suture thread 12 along or between the first and/or second distal sections 130, 230. The pledget "P" operates to prevent the suture loop 14 (FIG. 1) of the looped suture device 10 from being completely pulled through tissue as the looped suture device 10 is received in tissue.

[0036] FIGS. 3 and 4 illustrate the first and second free ends 112, 212 of the respective first and second proximal sections 110, 210 of the length of the suture thread 12 and the first and second weld portions 114, 214 (FIG. 2) of the respective first and second proximal sections 110, 210. The second weld portion 214 of the second proximal section 210 of the length of suture thread 12 overlaps with and is secured to the first weld portion 114 of the first proximal section 110 of the length of suture thread 12 to form a joined or weld section 140 of the length of suture thread 12. In certain aspects of the disclosure, the first and second weld portions 114, 214 are welded or fused together to form the weld section 140. In this manner, the weld section 140 of the length of suture thread 12 is formed of material from the overlapping portions of each of the first and second weld

portions 114, 214. Alternatively, the first and second weld portions 114, 214 are secured together using adhesives, solvents, or in any other suitable manner.

[0037] The weld section 140 includes a weld length "W_L". In certain aspects of the disclosure, the weld length "W_L" is between 0.25 inches and 0.5 inches. It is envisioned that the weld length "W_L" may be less than 0.25 inches or more than 0.5 inches.

[0038] As noted above, the first weld portion 114 of the first proximal section 110 of the length of suture thread 12 is spaced from the first free end 112 of the first proximal section 110. In this manner, the first free end 112 of the first proximal section 110 of the length of suture thread 12 is spaced from the weld section 140 to accommodate securing the surgical needle 16 to the first proximal section 110 of the length of suture thread 12.

[0039] The surgical needle 16 of the looped suture device 10 is secured to the first free end 112 of the first proximal section 110 of the length of suture thread 12. The surgical needle 16 includes a curved body 300 with a sharpened first end 302 for piercing tissue and a second end 304 defining an opening 305 for receiving the first free end 112 of the first proximal section 110 of the length of suture thread 12. Although shown as being curved, it is envisioned that the surgical needle 16 of the looped suture device 10 may include any suitable surgical needle. The first free end 112 of the first proximal section 110 of the length of suture thread 12 is secured within the opening 305 in the second end 304 of the surgical needle 16 in any suitable manner. In one aspect of the disclosure, the first free end 112 of the first proximal section 110 of the length of suture thread 12 is secured within the opening 305 by swaging the second end 304 of the surgical needle 16 about the first free end 112. It is envisioned that the first free end 112 may be secured within the opening using adhesive, friction fit, mechanical fasteners, or in any other suitable manner.

[0040] The second end 304 of surgical needle 16 of the looped suture device 10 includes a first diameter "D_N". The first free end 112 of the first proximal section 110 of the length of suture thread 12 includes a second diameter "D_S". The first diameter "D_N" is slightly larger than the second diameter "D_S" to accommodate the opening 305. The opening 305 in the surgical needle 16 is sized to receive the first free end 112 of the first proximal section 110.

[0041] In certain aspects of the disclosure, the surgical needle 16 of the looped suture device 10 is secured to the first free end 112 of the first proximal section 110 of the length of suture thread

12 such that the second free end 212 of the second proximal section 210 is on the same side of the suture loop 14 as an inner curved surface 300a of the curved body 300 of the surgical needle 16. The positioning of the inner curved surface 300a of the surgical needle 16 on the same side as the second free end 212 of the second proximal section 210 of the length of suture thread 12, i.e., aligned with the second free end 212, may reduce drag of the suture loop 14 as the looped suture device 10 is received through tissue.

[0042] A distance between the surgical needle 16 and the second free end 212 of the second proximal section 210 of the length of suture thread 12, i.e., the weld section 140, may include a gap length "G_L". In certain aspects of the disclosure, the gap length "G_L" is between 0.006" and 1.0", although shorter and longer distances are envisioned. It is further envisioned that the second fee end 212 of the second proximal section of the length of suture thread 12 may contact the surgical needle 16, i.e., no gap length between the second free end 212 and the surgical needle 16. The closer the weld section 140 is to the surgical needle 16, the less drag on the suture loop 14 as the looped suture device 10 is received through tissue.

[0043] As noted above, in certain aspects of the disclosure, the second free end 212 of the second proximal section 210 of the length of suture thread 12 may include the tapered surface 212a. The tapered surface 212a of the second free end 212 of the second proximal section 210 of the suture thread 12 facilitates receipt of the suture loop 14 of the looped suture device 10 through tissue. of More particularly, the tapered surface 212a the second free end 212 of the second proximal section 210 of the length of suture thread 12 reduces drag on the suture loop 14 during receipt of the looped suture device 10 through tissue.

[0044] Methods of forming the looped suture device 10 will now be described with reference to the drawings. The methods of forming the looped suture device 10 will only be described to the extend necessary to fully disclose the aspects of the disclosure. For a detailed description of various loop forming methods, please refer to U.S. Pat. Nos. 8,056,599, 8,403,017 ("the '017 patent"), and/or 8,590,588.

[0045] As noted above, any or all of the first and second proximal section 110, 210, the first and second intermediate section 120, 220, and the first and second distal sections 130, 230 of the length of suture thread 12 of the looped suture device 10 may include barbs. For a detailed description of a system and method of forming barbs on a length of suture thread, please refer to

U.S. Pat. No. 11,000,273. It is envisioned that barbs may be formed on the length of suture thread 12 in any suitable manner, and as noted above, in any suitable configuration. It is also envisioned that the looped suture device 10 may include no barbs.

[0046] FIGS. 5-8 illustrate the joining of the second proximal section 210 of the length of suture thread 12 to the first proximal section 110 of the length of suture thread 12 to form the suture loop 14. The first and second proximal sections 110, 210 of the length of suture thread 12 are joined using a welding assembly 400. The welding assembly 400 includes a first anvil member 402 and a second anvil member 404. Either or both of the first and second anvil members 402, 404 may be secured to an ultrasonic/heating device (not shown). The first anvil member 402 may include a first channel 403 and the second anvil member 404 may include a second channel 405. The first and second channels 403, 405 of the respective first and second anvil members 402, 404 are configured to receive the respective first and second weld portions 114, 214 of the respective first and second proximal sections 110, 210 of the length of suture thread 12. Although shown including first and second channels 403, 405, it is envisioned that either or both of the respective first and second anvil members 402, 404 may by flat, i.e., without a channel.

[0047] FIG. 7 illustrates the first and second proximal sections 110, 210 received within the welding apparatus 400 prior to activation of the one or more ultrasonic/heating devices. The first weld portion 114 of the first proximal section 110 of the length of suture thread 12 is positioned within a first channel 403 of a first anvil member 402 and the second weld portion 214 of the second proximal section 210 of the length of suture thread 12 is positioned within a second channel 405 of a second anvil member 404. In this manner, the second weld portion 214 of the length of suture thread 12 overlaps the first weld portion 114 of the length of suture thread 12.

[0048] Once the first and second proximal sections 110, 210 of the length of suture thread 12 are positioned relative to each other and the respective first and second anvil members 402, 404 of the welding assembly 400, one or both of the first or second anvil members 402, 404 are approximated towards each other, as indicated by arrow "C", to secure the second weld portion 214 of the second proximal section 210 to the first weld portion 114 of the first proximal section 110, thereby forming suture loop 14 (FIG. 5).

[0049] As noted above, the first and second proximal sections 110, 210 may alternatively be joined together using adhesives, solvents, or in any other suitable manner.

[0050] FIG. 9 illustrates the surgical needle 16 being secured to the first free end 112 of the length of suture thread 12. As known in the art, an anvil assembly 500 including at least a first anvil member 502 and a second anvil assembly 504 is used to swage the second end 304 of the surgical needle 16 about the first free end 112 of the first proximal section 110 of the length of suture thread 12. More particularly, the first anvil member 502 and the second anvil member 504 are approximated relative to each other and the second end 304 of the surgical needle 16, as indicated by arrows "E" and "F", respectively, to compress or otherwise deform the second end 304 of the surgical needle 16 to frictionally engage the first free end 112 of the first proximal section 110 of the length of suture thread 12, thereby retaining the first free end 112 within the opening 305 in the second end 304. Alternatively, the surgical needle 16 may be secured to the first free end 112 of the first proximal portion 110 in any suitable manner.

[0051] It is envisioned that the surgical needle 16 may be secured to the first free end 112 of the first proximal section 110 of the length of suture thread 12 prior to forming the suture loop 14. It is further envisioned that the surgical needle 16 may be secured to the first free end 112 of the first proximal section 10 of the length of suture thread 12 prior to forming barbs on the length of suture thread 12. In this manner, the surgical needle 16 may be used to facilitate securing the length of suture thread 12 as barbs are formed along the length of suture thread 12.

[0052] In certain aspects of the disclosure, the second free end 212 of the second proximal section 210 of the length of suture thread 12 includes the tapered surface 212a. FIG. 10 illustrates the forming of the tapered surface 212a subsequent to the suture loop 14 being formed and subsequent to the surgical needle 16 being secured to the length of suture thread 12. It is envisioned that the tapered surface 212a may be formed on the second free end 212 at any time during the forming of the looped suture device 10.

[0053] As depicted in FIG. 10, in one aspect of the disclosure, a cutting assembly 600 includes a knife blade 602 secured to an ultrasonic horn 604. The knife blade 602 is moved into engagement with the second free end 212 to form the tapered surface 212a.

[0054] It is envisioned that the tapered surface 212a may be formed in any suitable manner. In other aspects of the disclosure, the tapered surface 212a may be formed during the welding of the first weld portion 114 of the first proximal section 110 of the length of suture thread 12 to the second weld portion 214 of the second proximal section 210 of the length of suture thread 12.

More particularly, as described in the '017 patent, the second anvil member 404 (FIG. 6) may include a forming member (not shown) that creates a tapered surface as the first and second anvil members 402, 404 are approximated relative to each other.

[0055] Persons skilled in the art will understand that the devices and methods specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary aspects. It is envisioned that the elements and features illustrated or described in connection with the exemplary aspects may be combined with the elements and features of another without departing from the scope of the disclosure. As well, one skilled in the art will appreciate further features and advantages of the disclosure based on the above-described aspects. Accordingly, the disclosure is not to be limited by what has been particularly shown and described, except as indicated by the appended claims.

WHAT IS CLAIMED IS:

1. A looped suture device comprising:

a length of suture thread including a first proximal portion including a first free end, a second proximal portion including a second free end, a first intermediate portion extending from the first proximal portion, a second intermediate portion extending from the second proximal portion, a first distal portion extending from the first intermediate portion, and a second distal portion extending between the second intermediate portion and the first distal portion, the second proximal portion being secured to the first proximal portion at a joined section to form a loop; and

a surgical needle secured to the first free end of the length of suture thread, wherein the loop includes a length of at least six inches.

2. The looped suture device of claim 1, wherein a distance between the joined section and the surgical needle is less than one inch.

3. The looped suture device of claim 1, wherein the surgical needle is curved and includes an inner surface.

4. The looped suture device of claim 3, wherein the second free end aligns with the curved inner surface of the surgical needle.

5. The looped suture device of claim 1, wherein each of the first and second intermediate sections include barbs.

6. The looped suture device of claim 5, wherein the barbs extend away from the surgical needle.

7. The looped suture device of claim 1, wherein the second free end engages the surgical needle.

8. The looped suture device of claim 1, wherein the first and second intermediate sections are the same length.

9. The looped suture device of claim 1, wherein the joined section includes a welded portion.

10. The looped suture device of claim 1, wherein the second free end includes a tapered surface.

11. A looped suture device comprising:

a length of suture thread including a first proximal portion including a first free end, a second proximal portion including a second free end, a first intermediate portion extending from the first proximal portion, a second intermediate portion extending from the second proximal portion, a first distal portion extending from the first intermediate portion, and a second distal portion extending between the second intermediate portion and the first distal portion, the second proximal portion being secured to the first proximal portion at a joined section to form a loop; and

a surgical needle secured to the first free end of the length of suture thread, wherein a distance between the joined section and the surgical needle is less than one inch.

12. The looped suture device of claim 11, wherein the surgical needle is curved and includes an inner surface.

13. The looped suture device of claim 12, wherein the second free end aligns with the curved inner surface of the surgical needle.

14. The looped suture device of claim 11, wherein each of the first and second intermediate sections include barbs.

15. The looped suture device of claim 14, wherein the barbs extend away from the surgical needle.

16. The looped suture device of claim 11, wherein the second free end engages the surgical needle.

17. The looped suture device of claim 11, wherein the first and second intermediate sections are the same length.

18. The looped suture device of claim 11, wherein the joined section includes a welded portion.

19. The looped suture device of claim 11, wherein the second free end includes a tapered surface.

20. A method of forming a looped suture device comprising:

forming a suture loop in a length of suture thread by securing a first free end of the length of suture thread to a portion of the length of suture thread spaced from a second free end of the length of suture thread to form a joined section; and

securing a surgical needle to the second free end of the length of suture thread within an inch of the joined section.

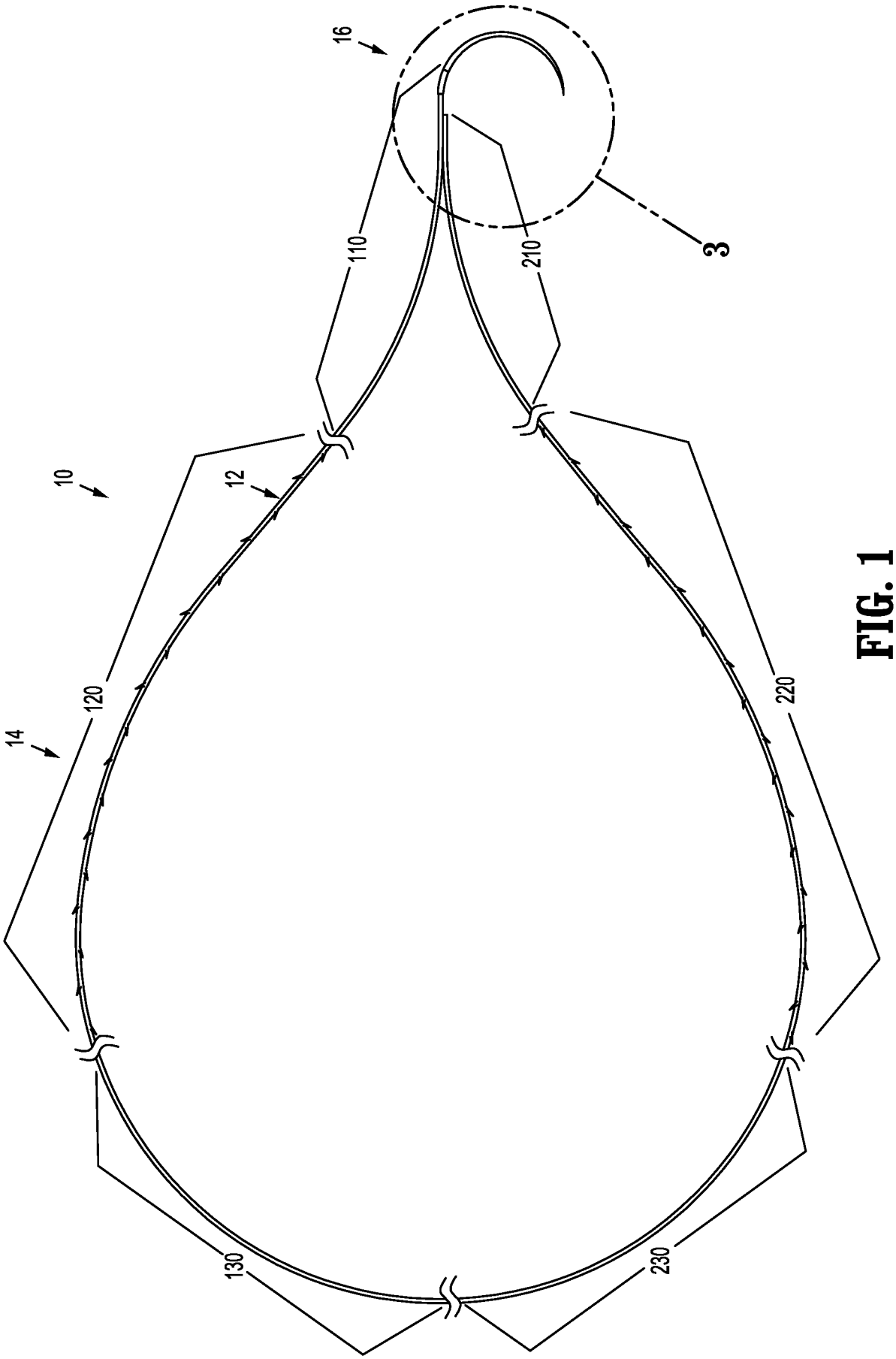


FIG. 1

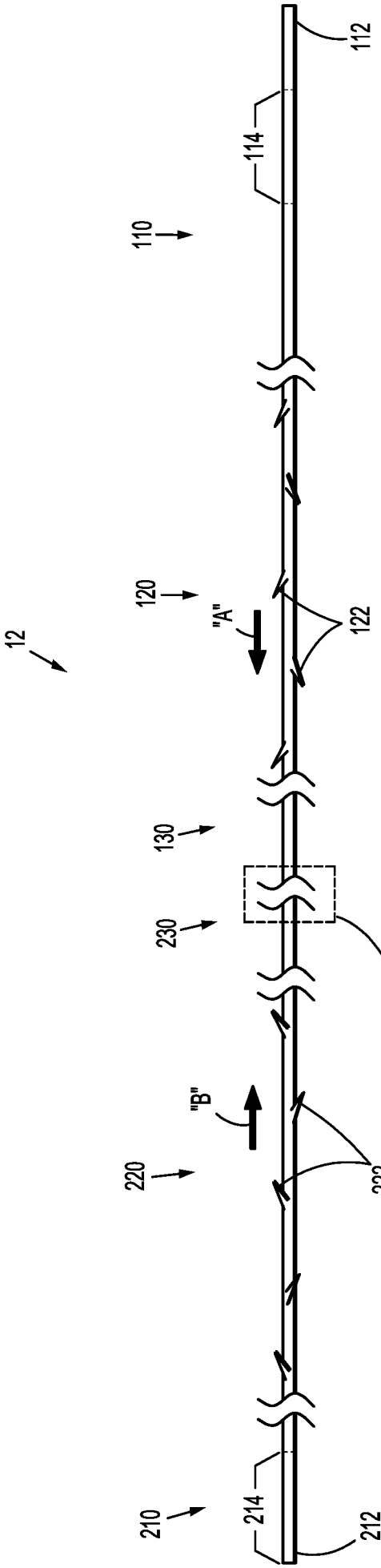
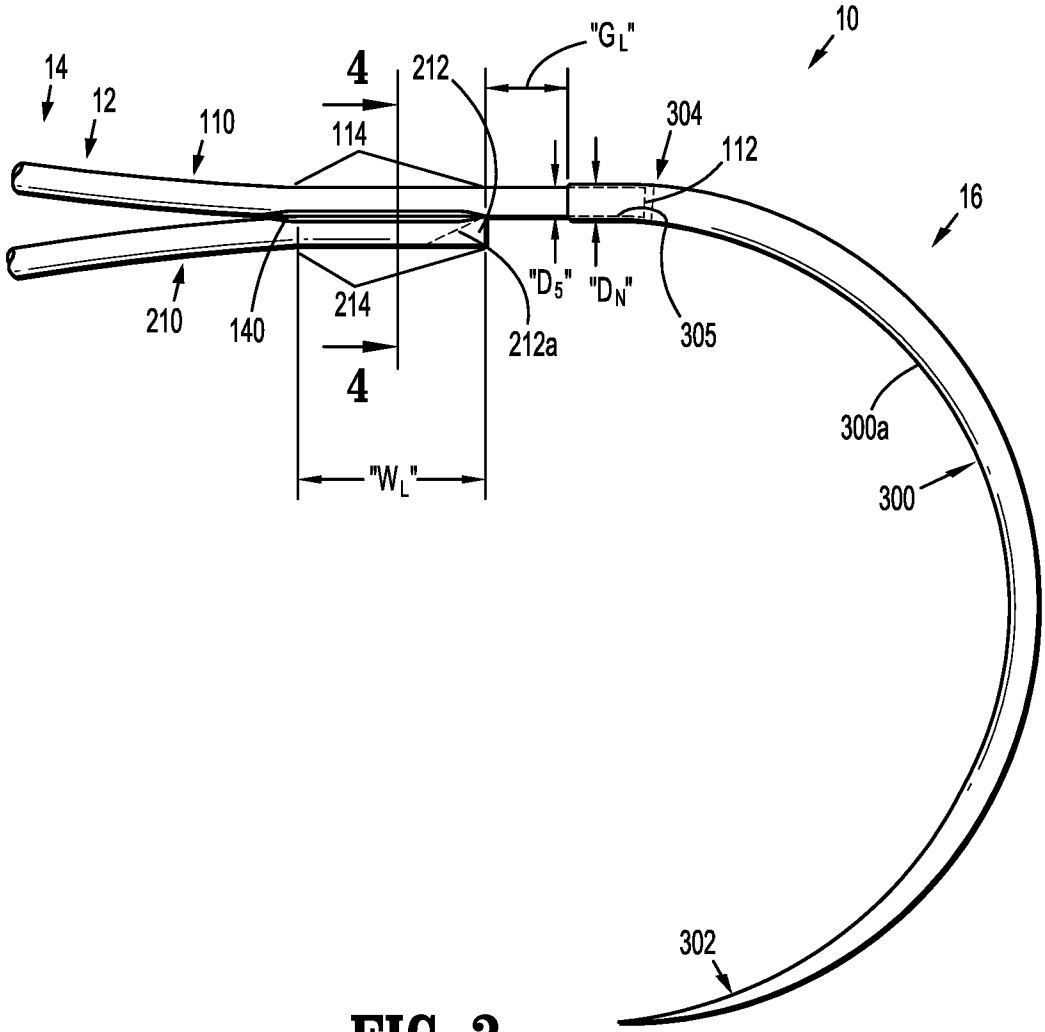


FIG. 2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14
12
110
4
212
"G_L"
114
304
112
16
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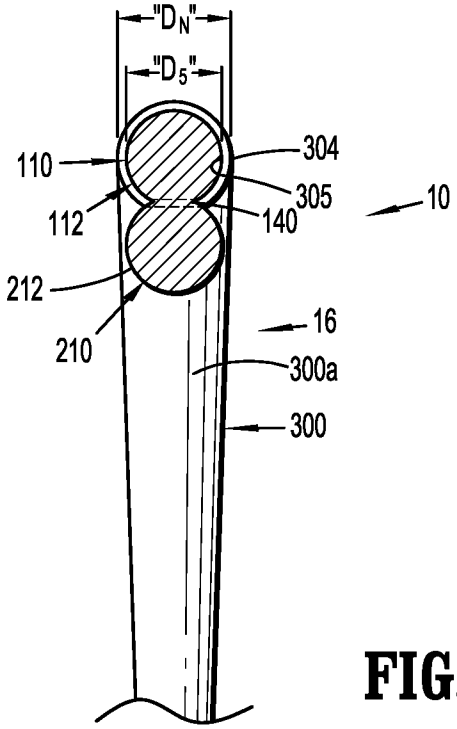
"D_N"
212a
305
4
300a
"W_L"
300
302

FIG. 3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"D_5"
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304
305
10
112
140
212
16
210
300a
300

FIG. 4

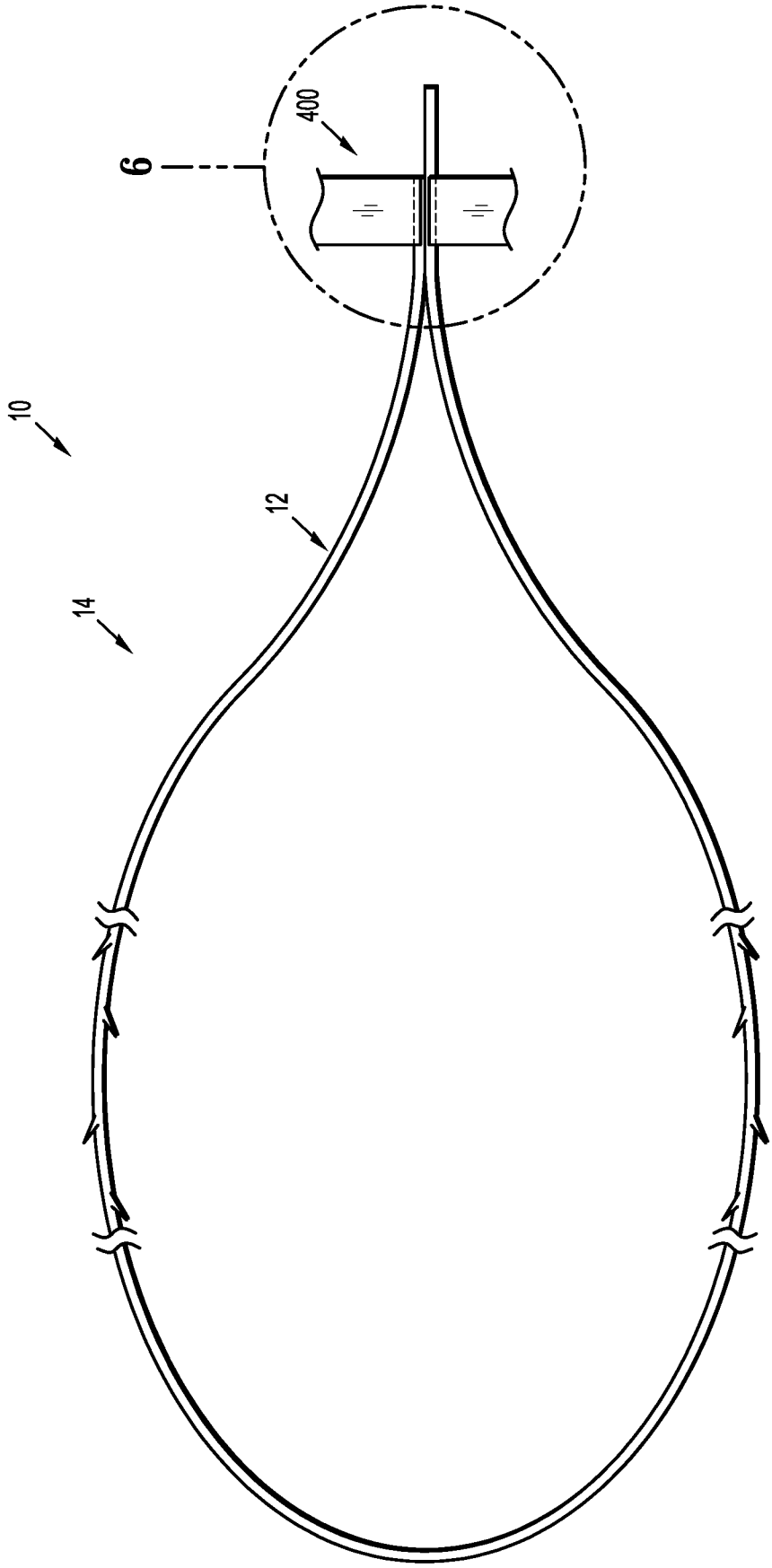

FIG. 5

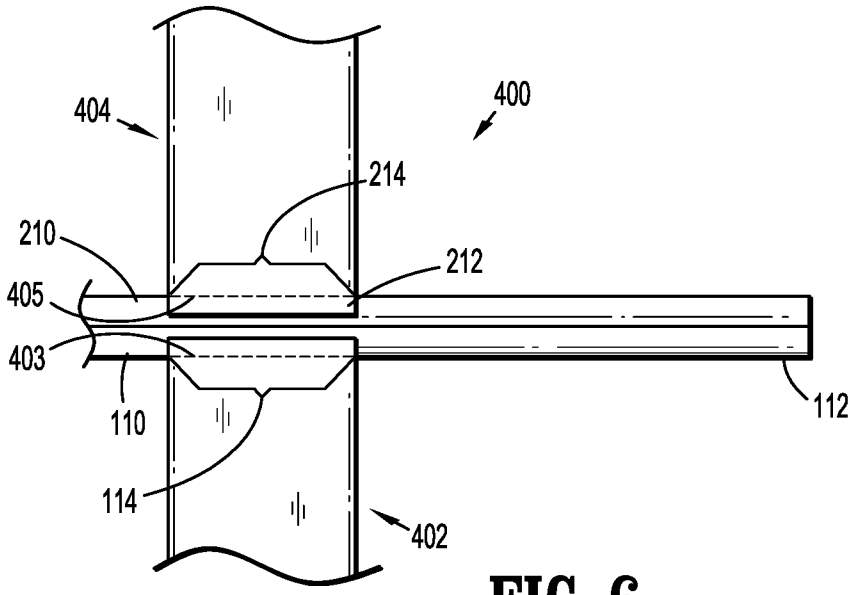

FIG. 6

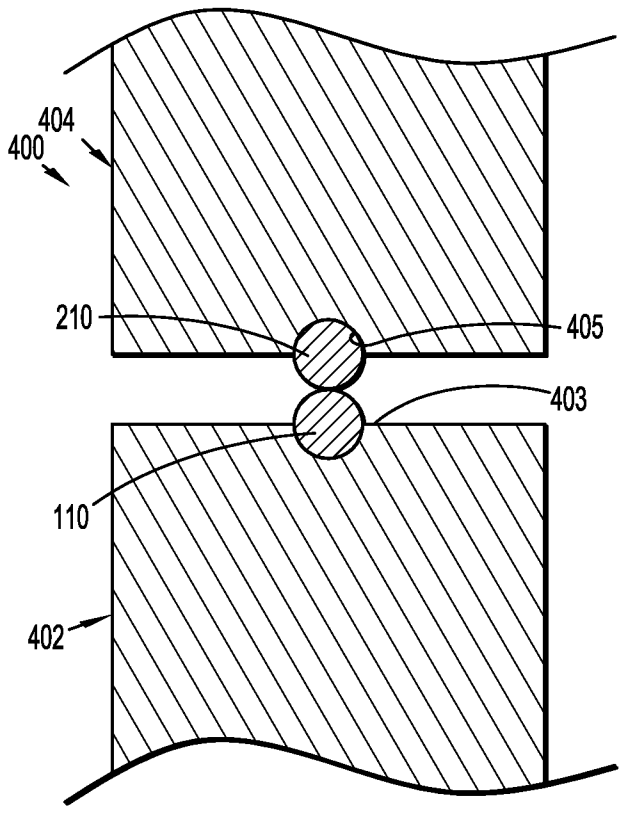

FIG. 7

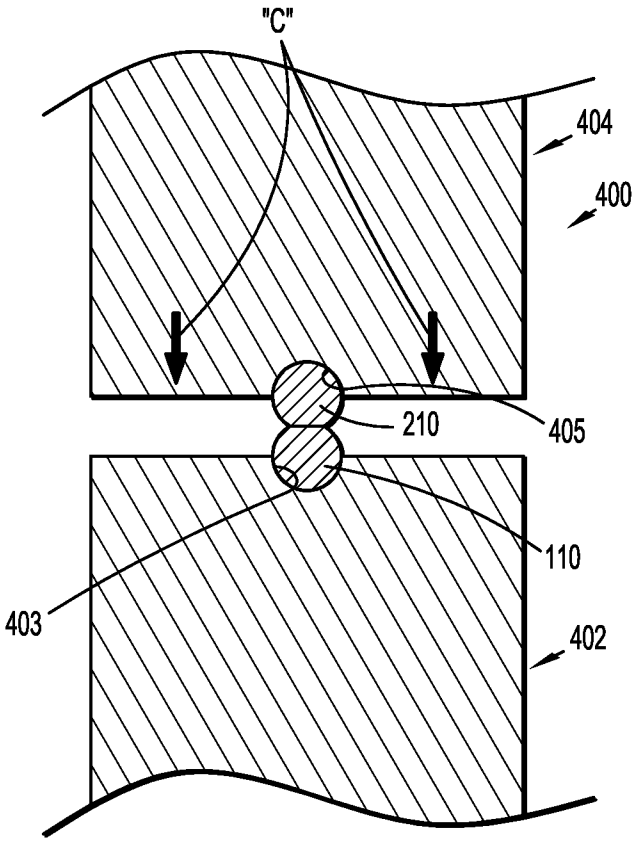

FIG. 8

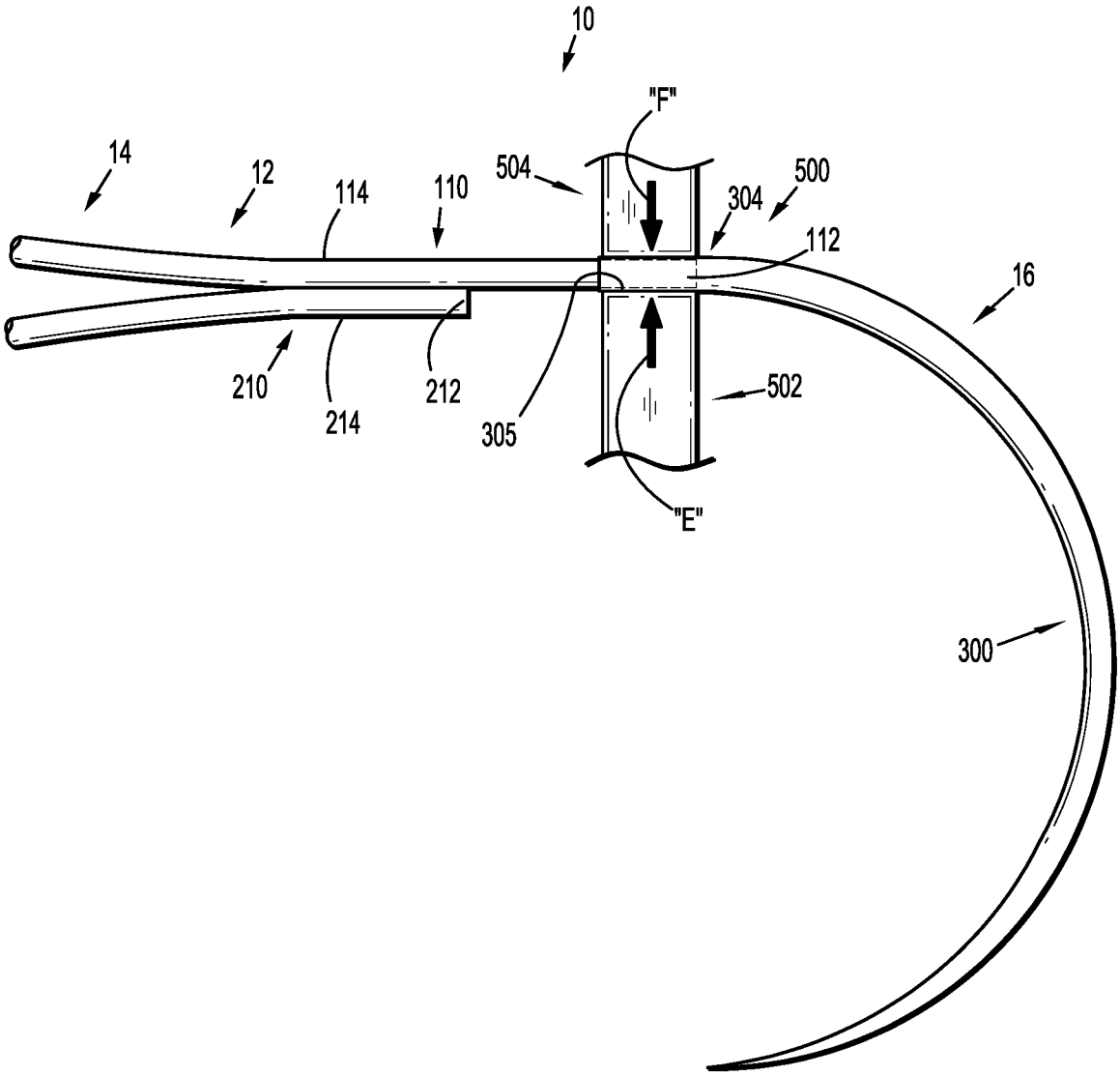

FIG. 9

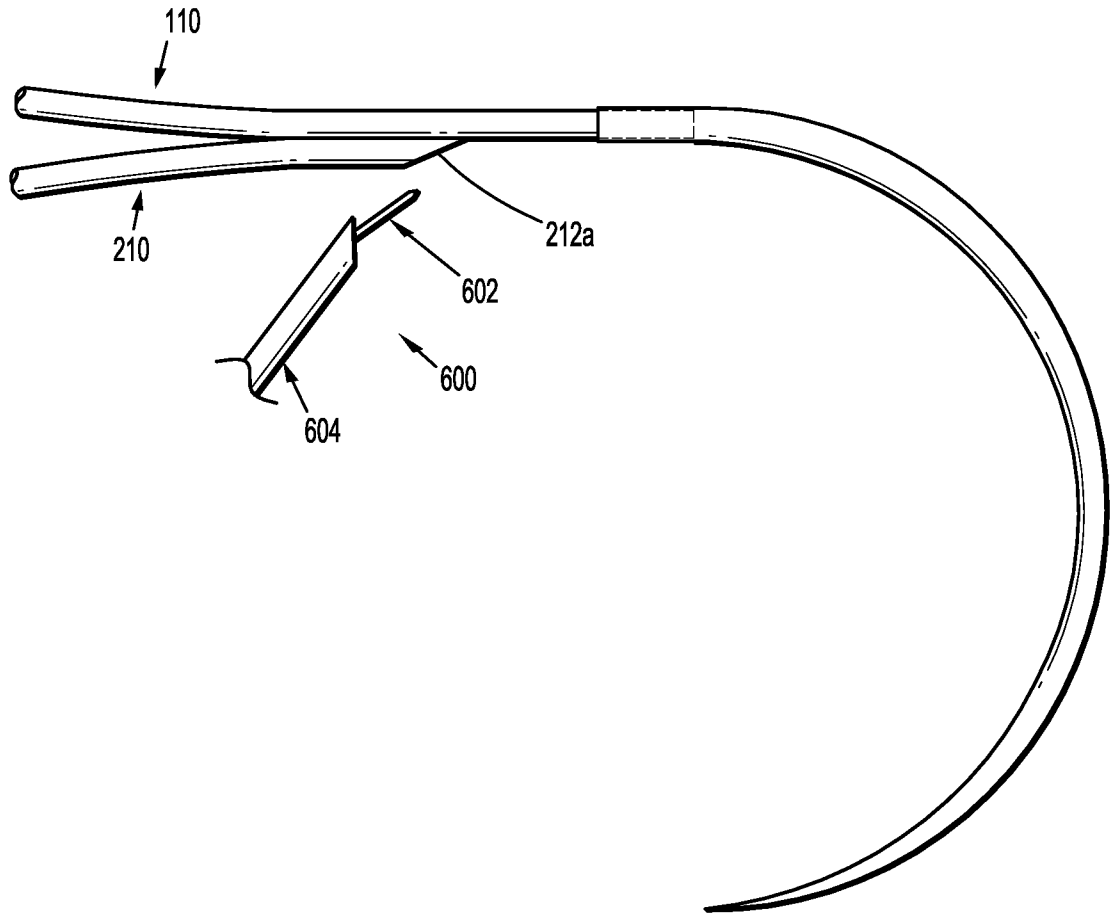

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2023/057859

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/06
ADD. A61B17/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 2008/281357 A1 (SUNG AN-MIN JASON [US] ET AL) 13 November 2008 (2008-11-13) paragraph [0015] - paragraph [0086]; figures 1-13D	1-9, 11-18,20 5,6 10,19
X Y A	WO 02/22025 A1 (AXYA MEDICAL INC [US]) 21 March 2002 (2002-03-21) paragraph [0012] - paragraph [0094]; figure 29	1,3-6,8, 9 10 2,7, 11-20
X Y A	US 5 830 234 A (WOJCIECHOWICZ ALEX F [US] ET AL) 3 November 1998 (1998-11-03) column 3, line 52 - column 6, line 38; figures 1-11	1,3,4, 8-10 5,6 2,7

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 December 2023	04/01/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kamp, Martin

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2023/057859

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2023/057859

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 2 168 755 A2 (TYCO HEALTHCARE [US]) 31 March 2010 (2010-03-31) figures 1A-1C, 5C, 6B	10
X	US 2012/136388 A1 (ODERMATT ERICH [CH] ET AL) 31 May 2012 (2012-05-31)	11-17,20
A	especially para. 85; paragraph [0022] - paragraph [0085]; figures 2a, 3a, 4a	18,19
X	US 2011/282386 A1 (FRIEDRICH VOLKER [ES] ET AL) 17 November 2011 (2011-11-17)	11-18,20
A	column 21 - column 125; figure 3A	19

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10

A looped suture device comprising:
a length of suture thread including different sections, a first free and and a second free end;
a surgical needle secured to the first free end of suture, wherein loop includes a length of at least six inches.

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2. claims: 11-20

A looped suture device comprising:
a length of suture thread including a first proximal portion including a first free end, a second proximal portion including a second free end, a first intermediate portion extending from the first proximal portion, a second intermediate portion extending from the second proximal portion, a first distal portion extending from the first intermediate portion, and a second distal portion extending between the second intermediate portion and the first distal portion, the second proximal portion being secured to the first proximal portion at a joined section to form a loop; and
a surgical needle secured to the first free end of the length of suture thread, wherein a distance between the joined section and the surgical needle is less than one inch.
AND
A method of forming a looped suture device comprising:
forming a suture loop in a length of suture thread by securing a first free end of the length of suture thread to a portion of the length of suture thread spaced from a second free end of the length of suture thread to form a joined section; and
securing a surgical needle to the second free end of the length of suture thread within an inch of the joined section.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2023/057859

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		ES 2409112 T3	25-06-2013
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		PT 2373226 E	03-05-2013
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