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(54) CANNULATED TELESCOPIC FEMORAL NECK SCREW DEVICE AND RELATED FIXATION METHOD

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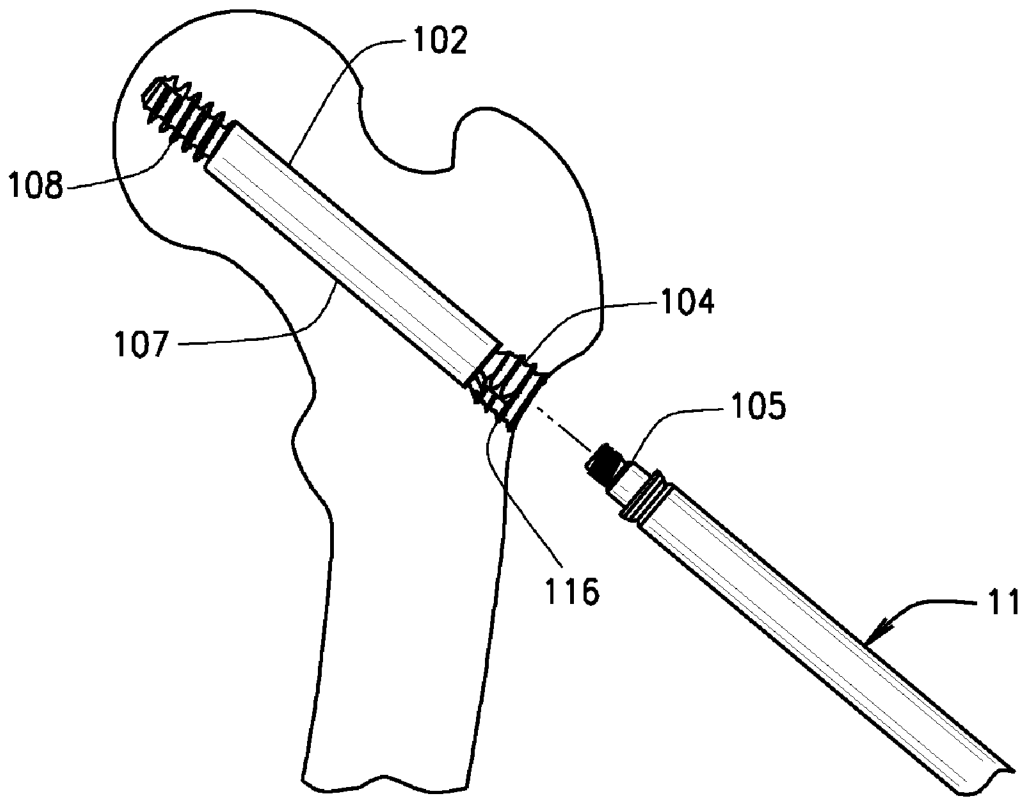
(57) **ABSTRACT**

A screw assembly and method developed for the fixation of femoral neck fractures without interruption of the growth process is disclosed. The screw assembly includes a male component that is attached to the lateral cortex and a female component that is attached at the proximal epiphysis. Anchorage of the components is achieved through screw-type fixation. The screw has a built-in feature that allows for free extension of its length as the fracture site or the slipped capital physeal plate heals and normal patient growth continues. Stable fixation and rotational stability are created at the fracture (slip) site while avoiding compression forces, thus avoiding premature closure of the physeal plate.



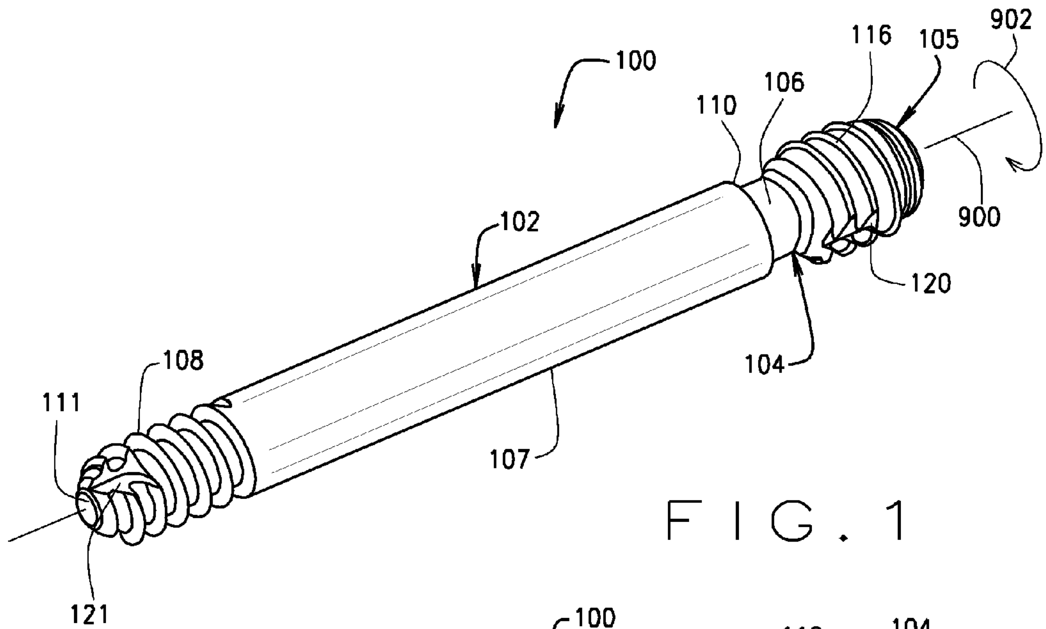


FIG. 1

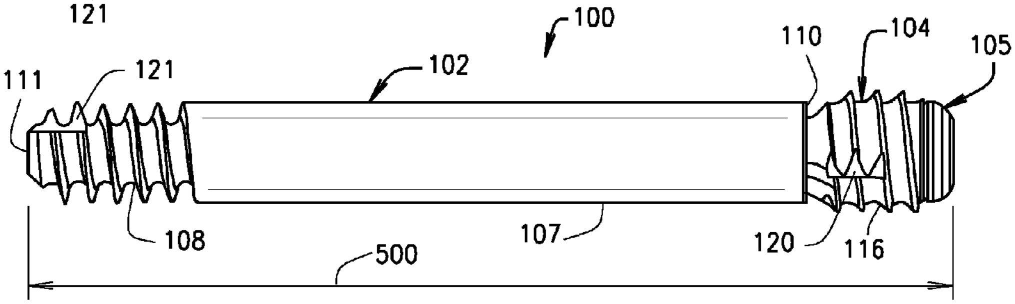


FIG. 2

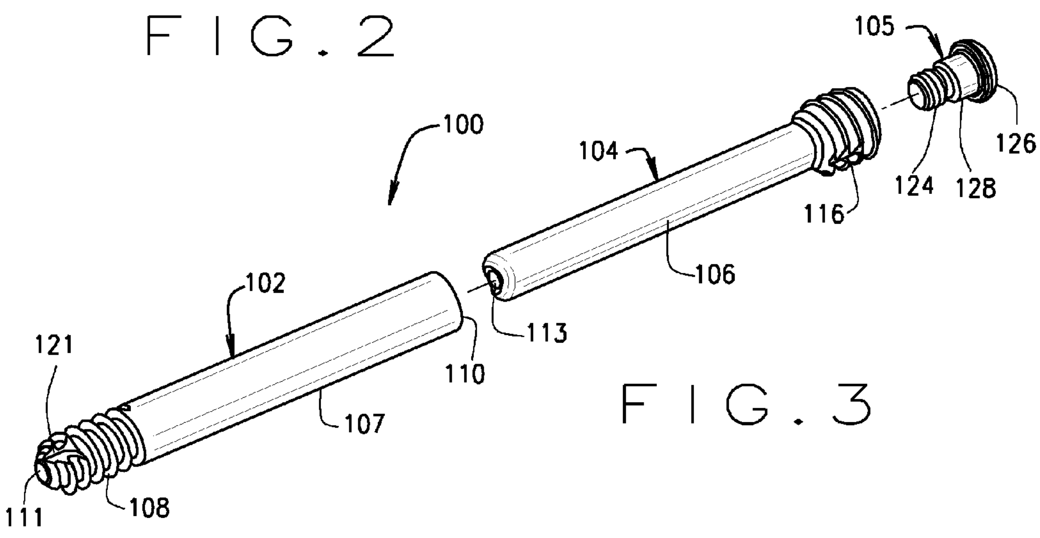


FIG. 3

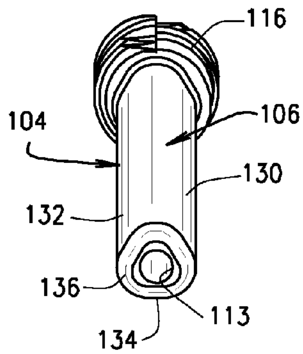


FIG. 3A

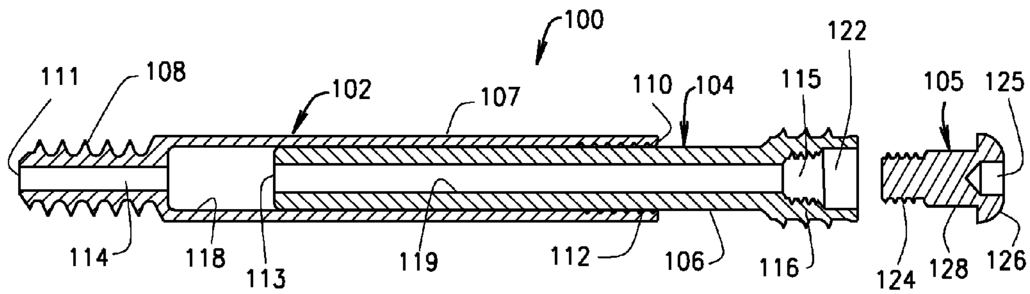


FIG. 4

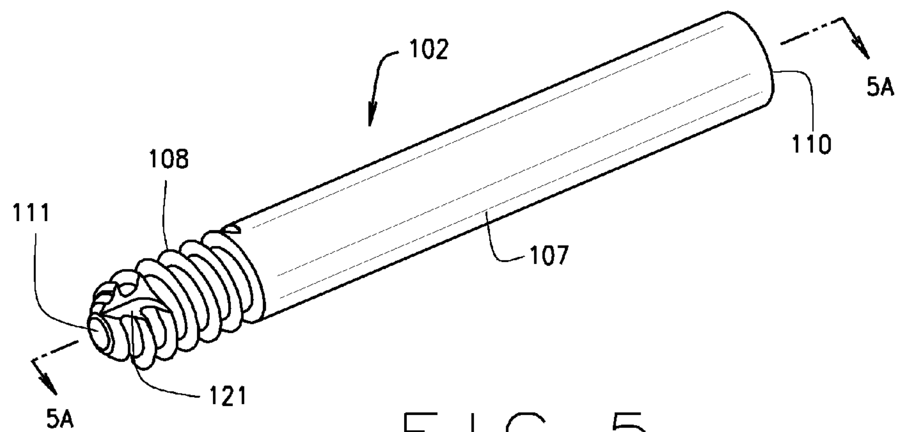


FIG. 5

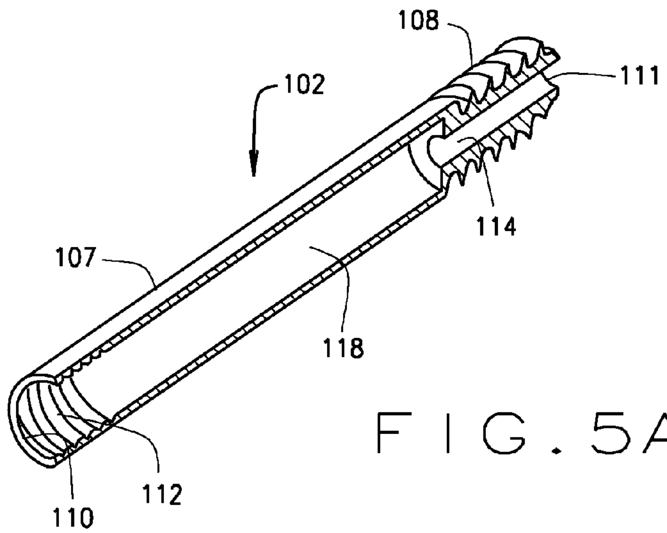


FIG. 5A

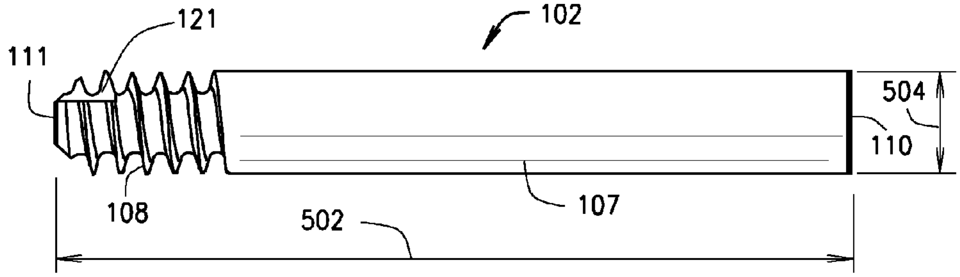


FIG. 6

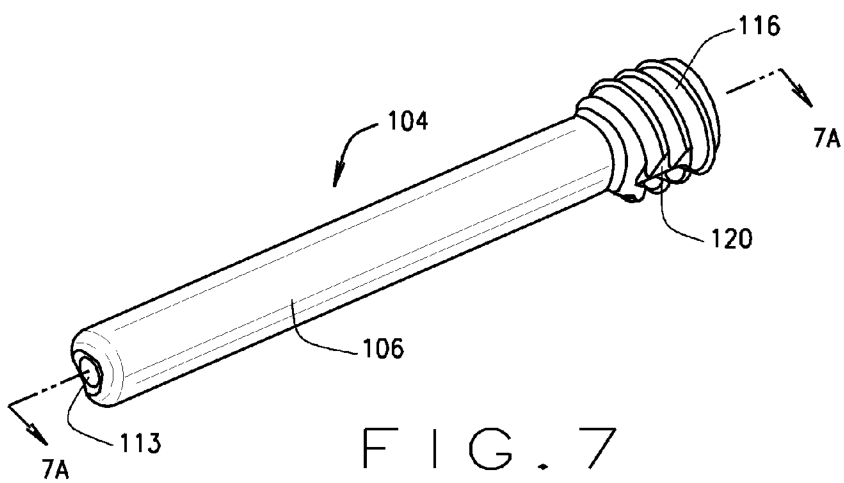


FIG. 7

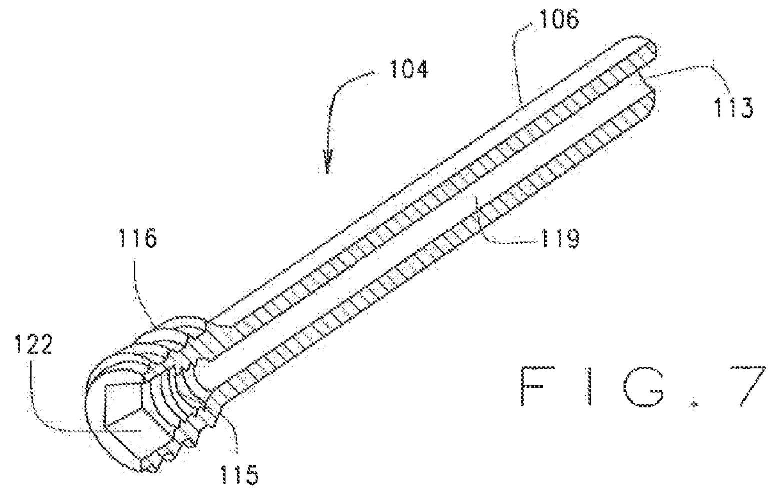


FIG. 7A

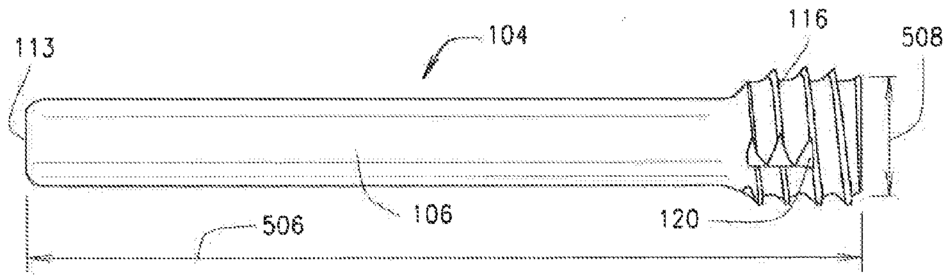


FIG. 8

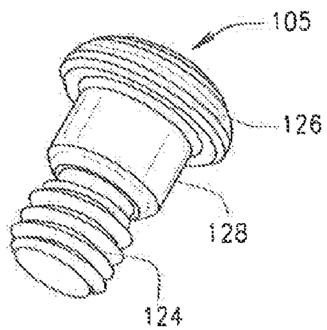


FIG. 9A

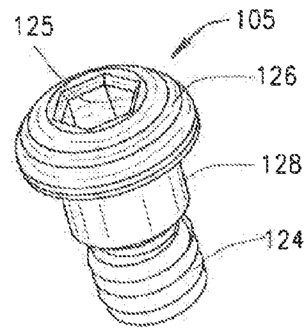


FIG. 9B

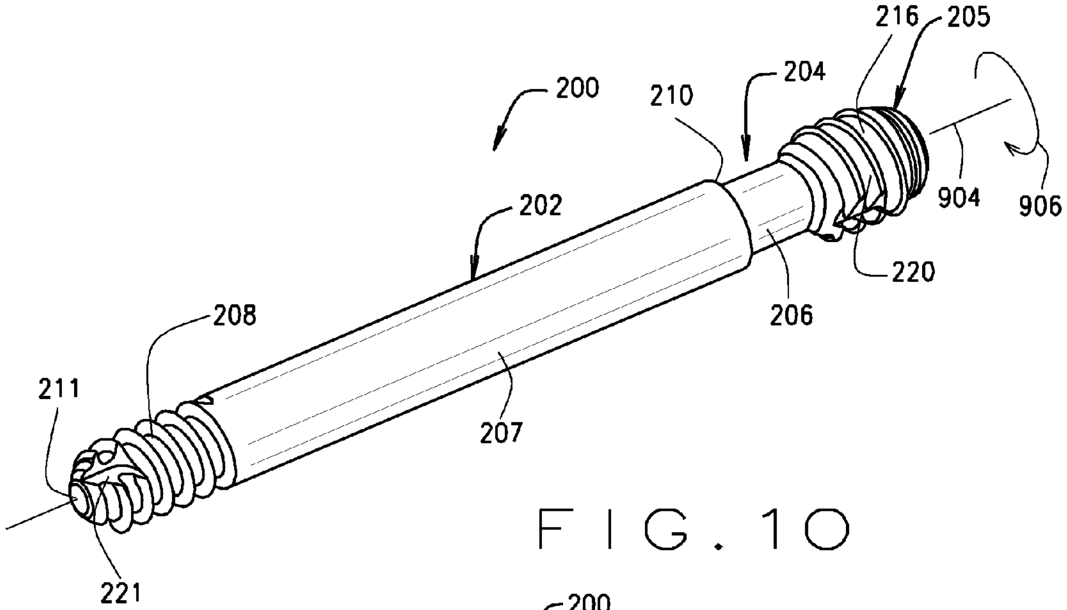


FIG. 10

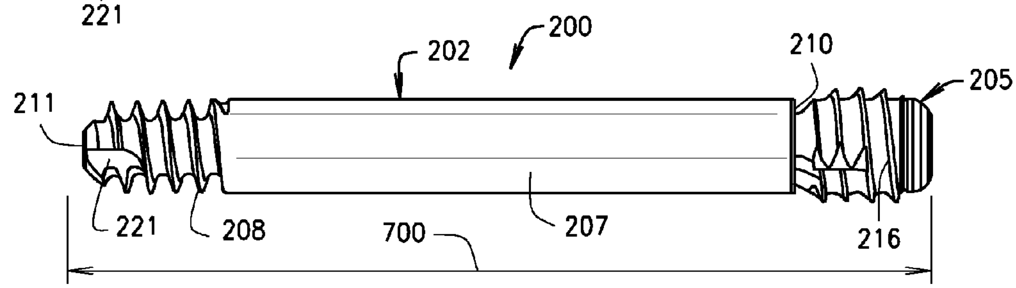


FIG. 11

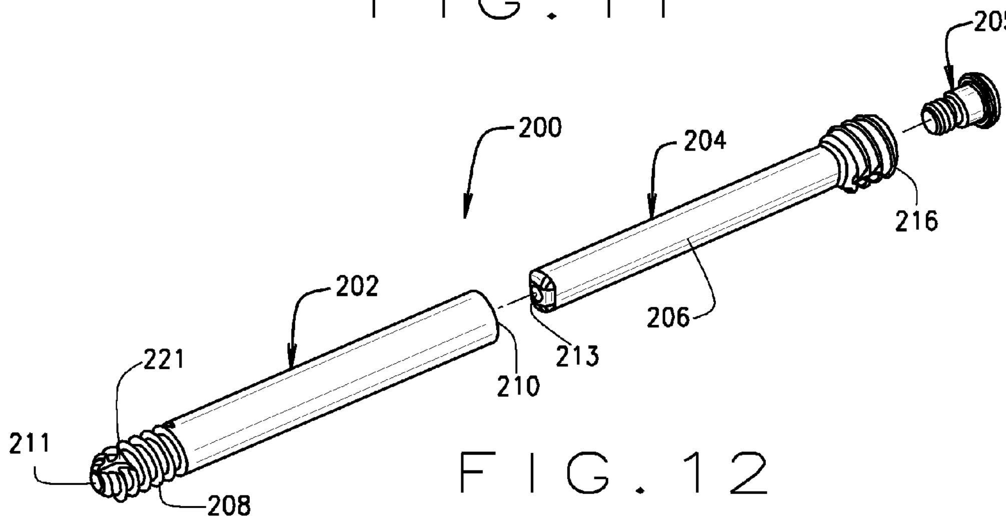


FIG. 12

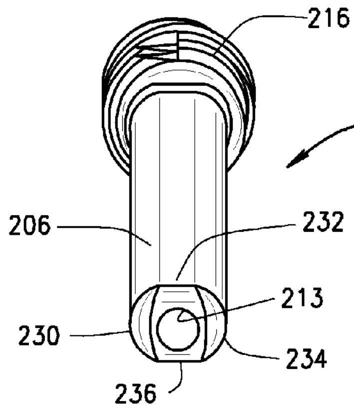


FIG. 12A

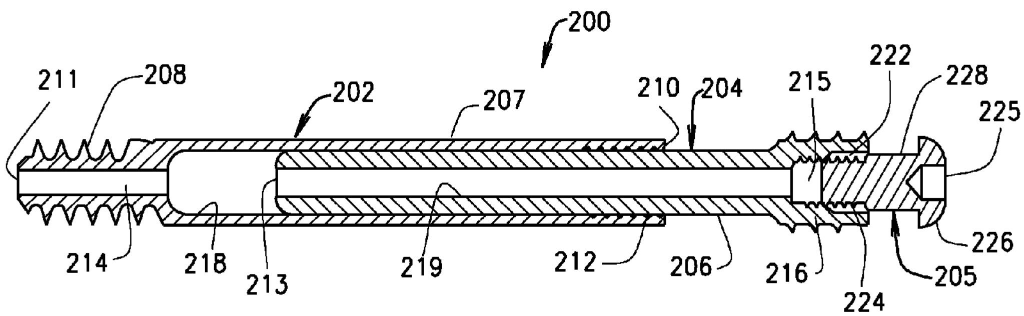


FIG. 13

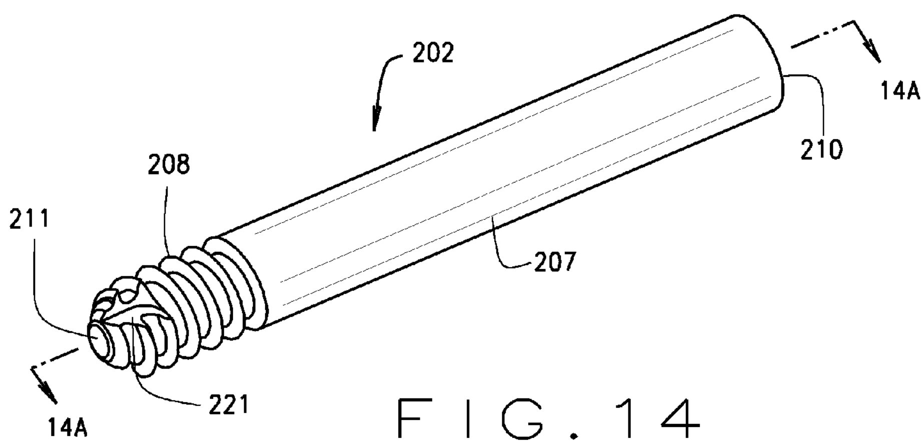


FIG. 14

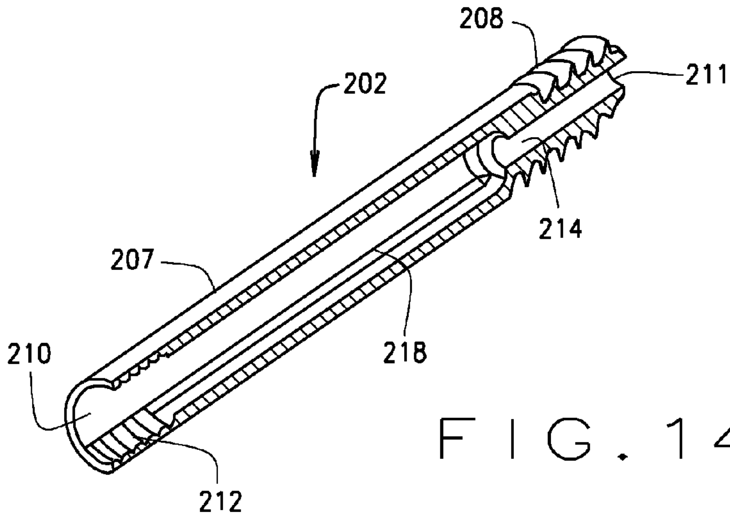


FIG. 14A

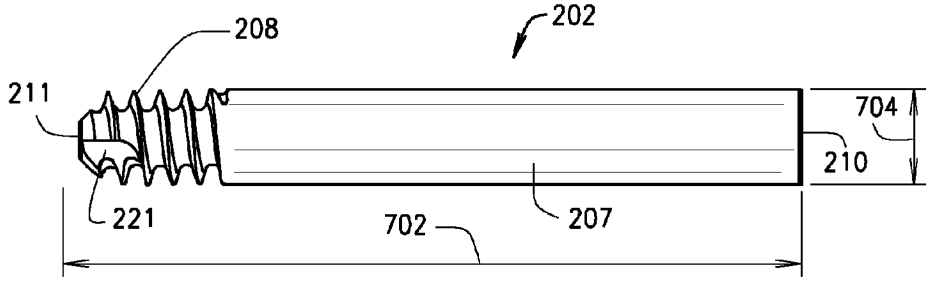


FIG. 15

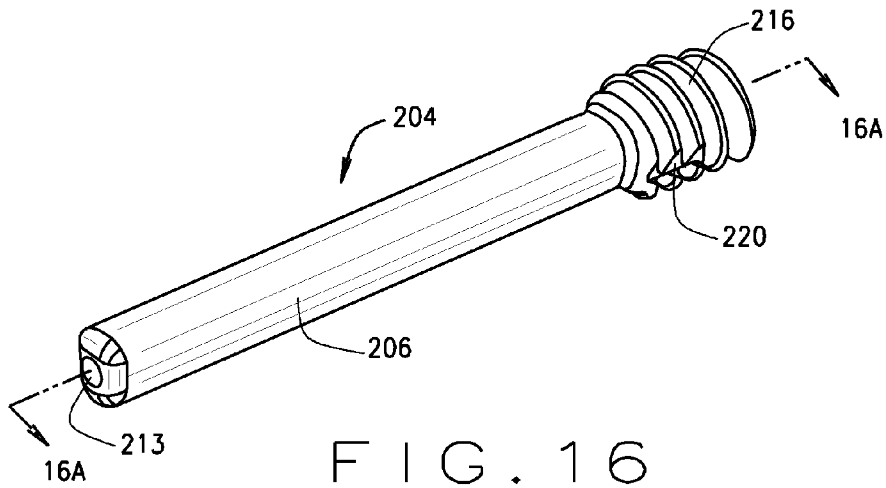


FIG. 16

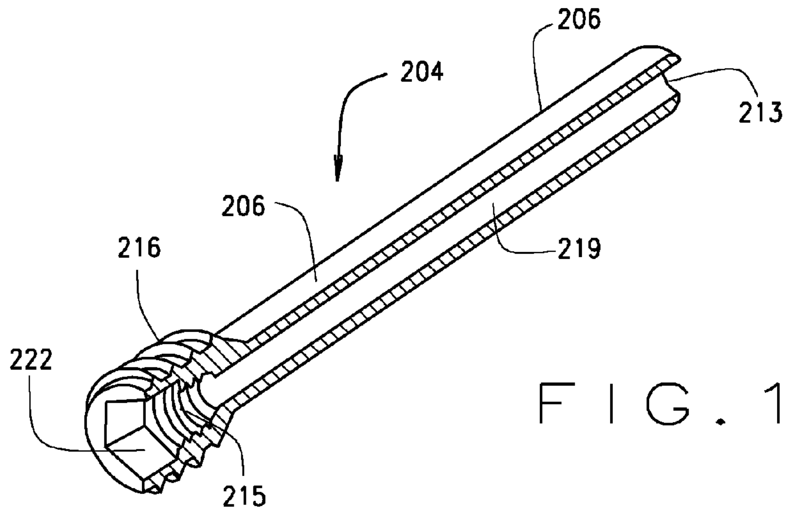


FIG. 16A

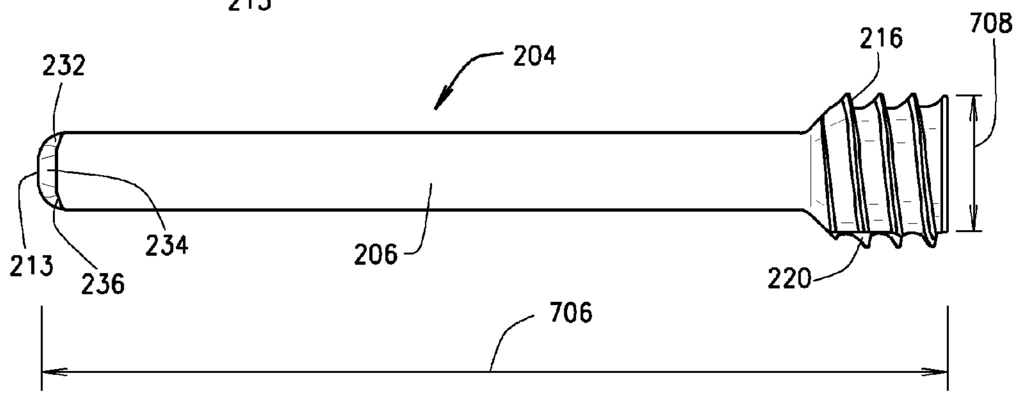


FIG. 17

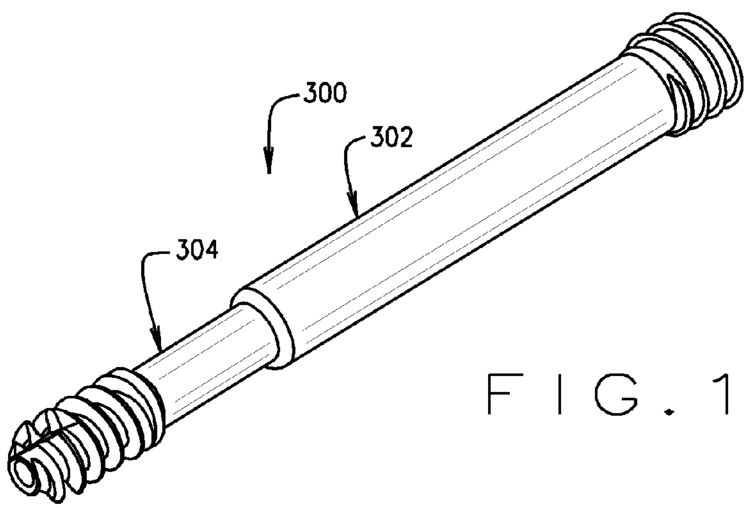


FIG. 18

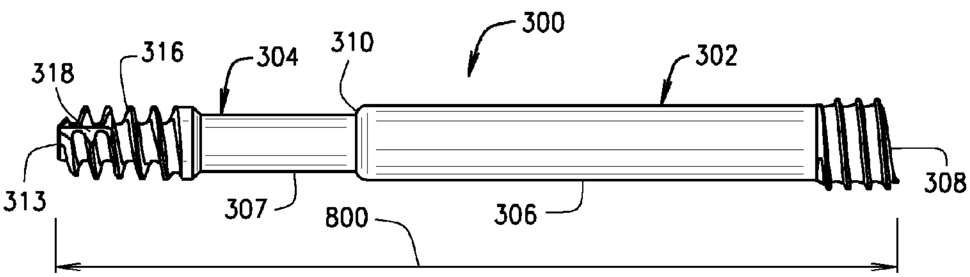


FIG. 19

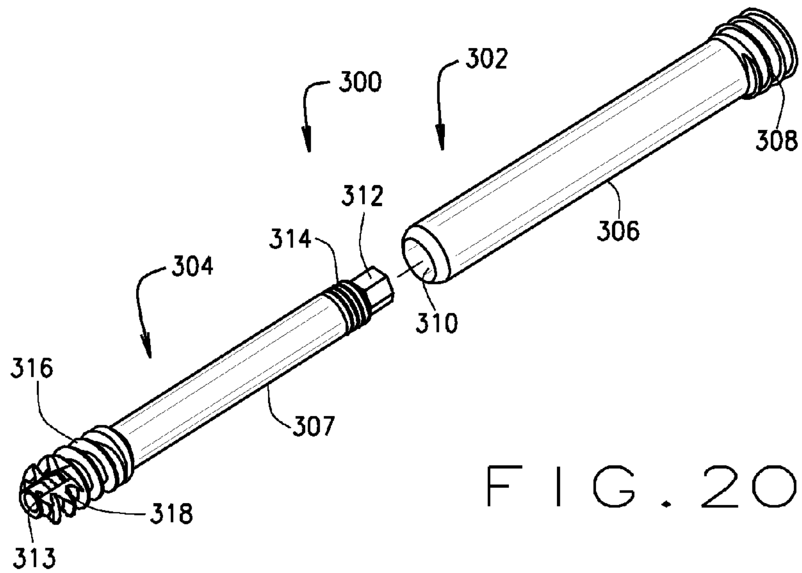


FIG. 20

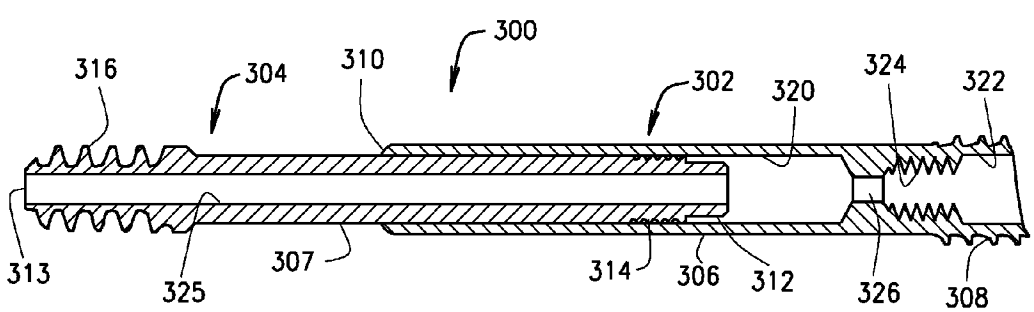


FIG. 21

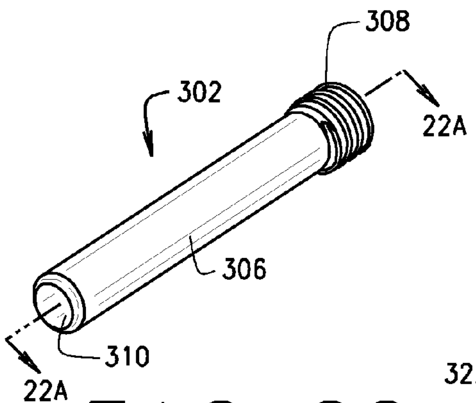


FIG. 22

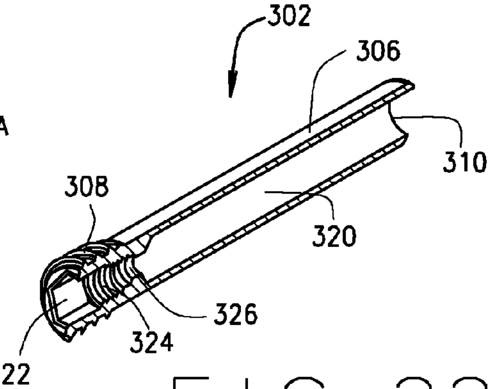


FIG. 22A

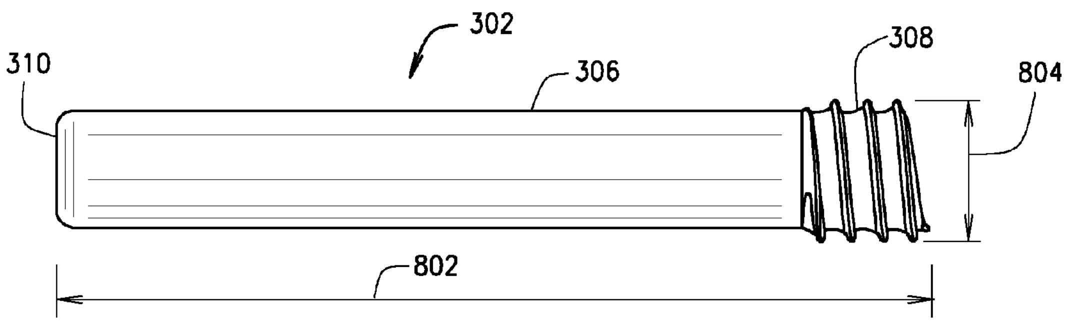


FIG. 23

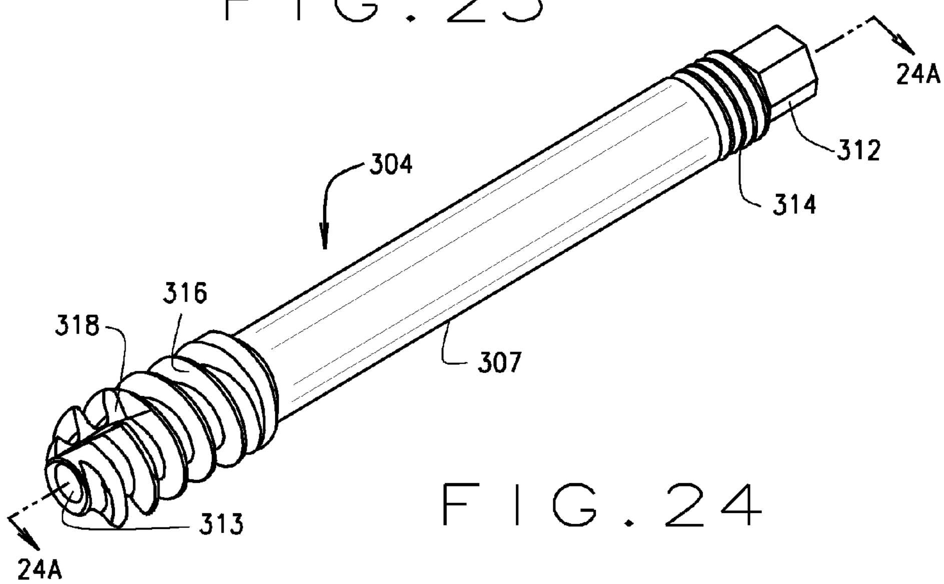


FIG. 24

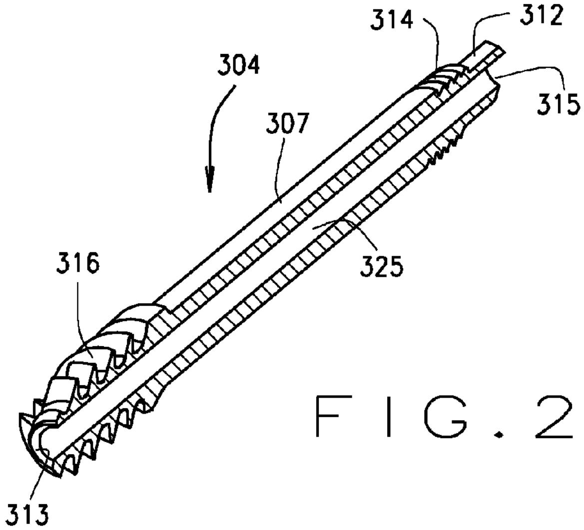


FIG. 24A

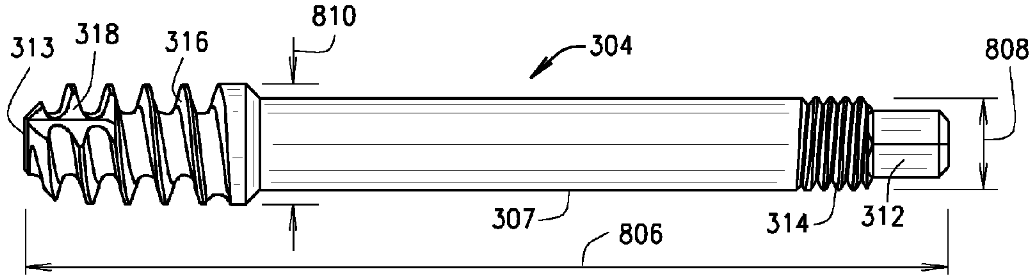


FIG. 25

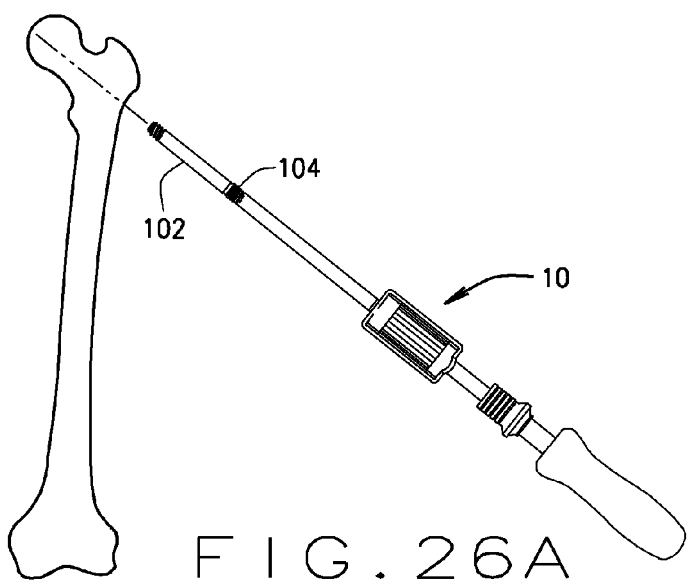


FIG. 26A

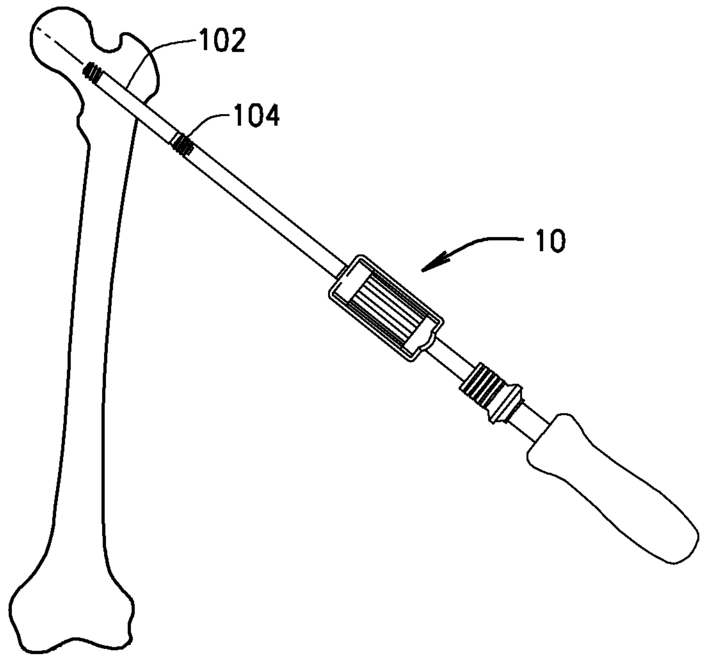


FIG.26B

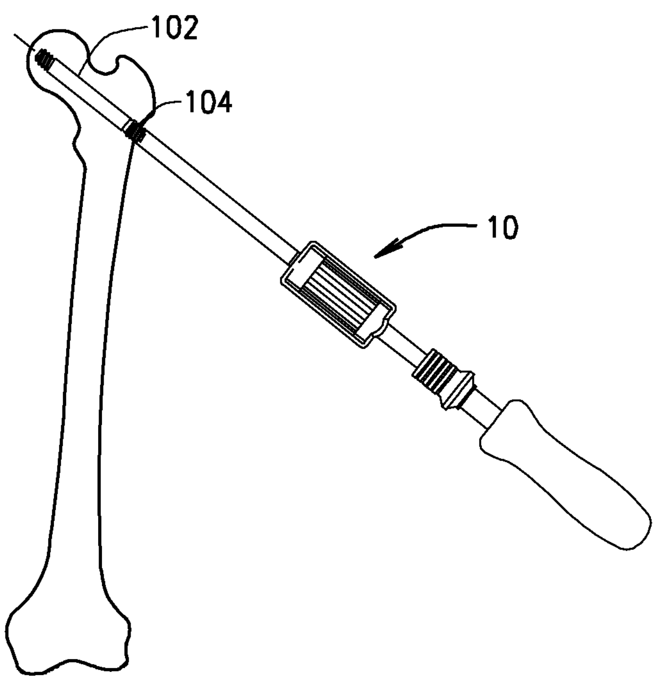


FIG.26C

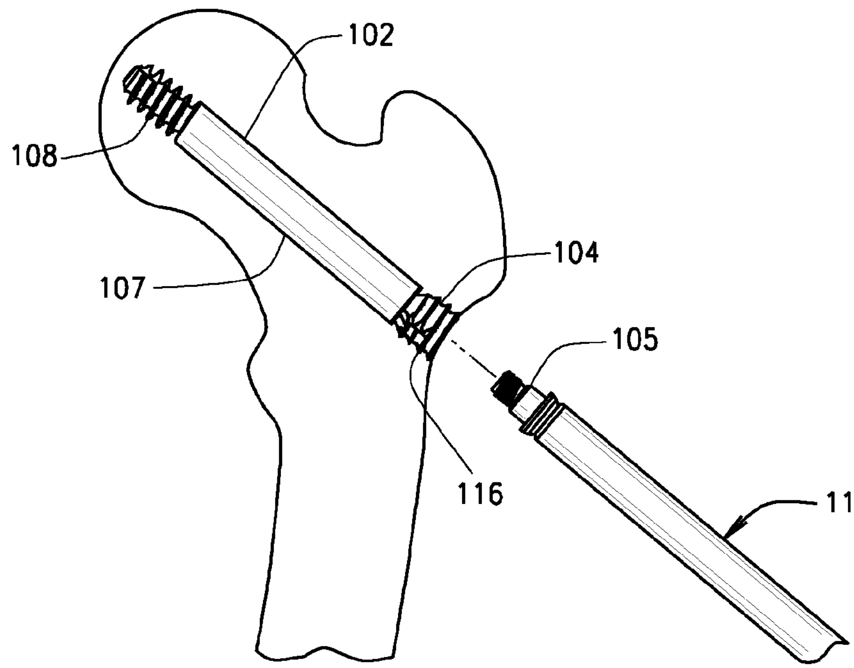


FIG. 26D

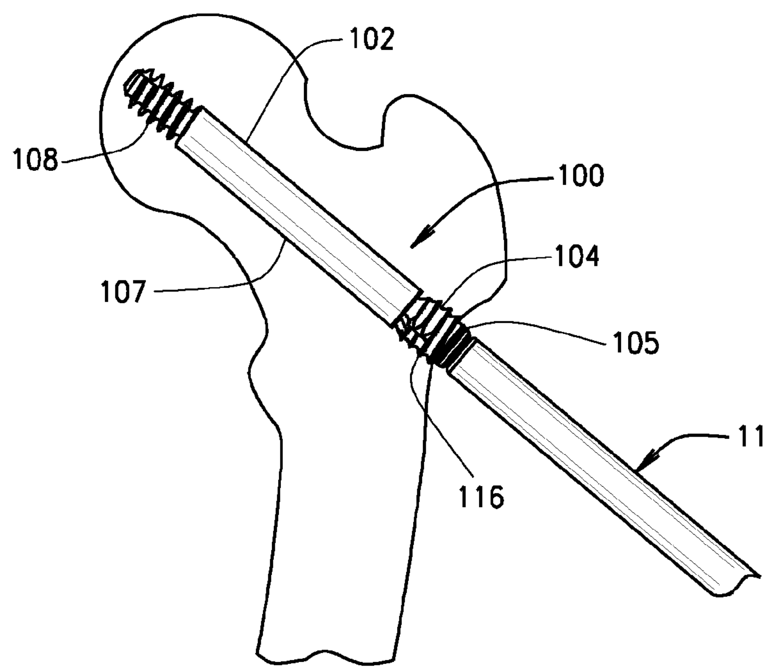


FIG. 26E

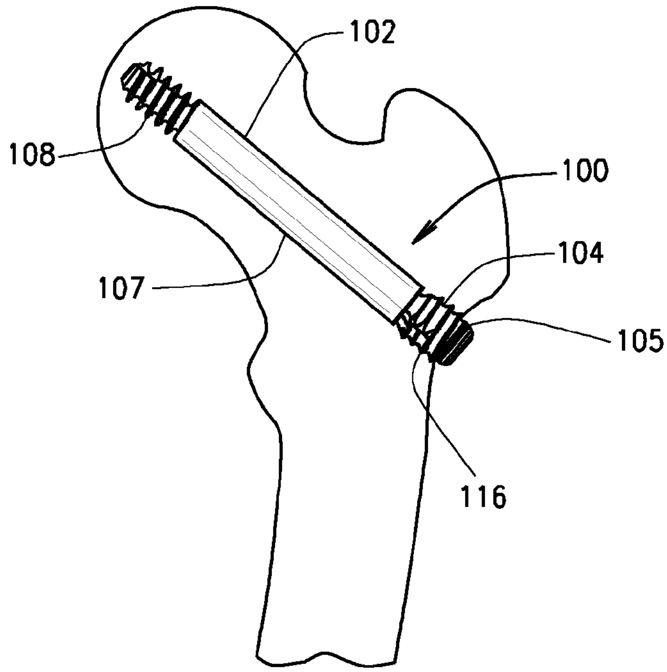


FIG. 26F

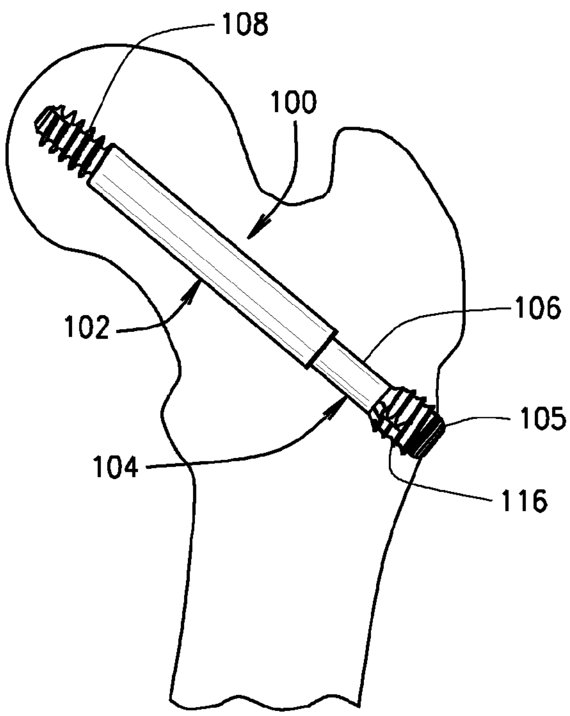


FIG. 26G

CANNULATED TELESCOPIC FEMORAL NECK SCREW DEVICE AND RELATED FIXATION METHOD

FIELD

[0001] The present document generally relates to a screw assembly system and method for the fixation of fractures along the femoral neck, and in particular to an improved cannulated bone screw assembly that enables the implant to be used for the fixation of bone fractures through the physeal plate (growth plate).

BACKGROUND

[0002] Cannulated screws have been used for internal fracture fixation, and a single screw placement through the femoral neck has become the preferred treatment for fractures through the physeal plate. Fractures through the physeal plate are more commonly referred to as Slipped Capital Femoral Epiphysis.

[0003] Generally, such a fixation device comprises a hollow shaft having a predetermined cross-section and provided with threaded sections beginning at the medial end of the device spanning a predetermined length of the shaft. The fixation device is placed parallel to the neck of the femur and secures the fracture with compressive force applied by the spherical lateral screw head at the lateral cortex. The prior art typically describes a variety of screw systems comprising different shaft diameters, shaft lengths, thread pitches and thread lengths in order to offer a fixation device for all possible locations and extents of the fracture sites. The general configuration of cannulated screws is well illustrated in U.S. Pat. No. 7,207,994. Such described screws are non self-adjustable in length and, therefore incapable of providing a surgical fixation to stabilize fractured bones during the healing process without disrupting the normal bone growth particularly in pediatric patients.

[0004] In another example described in U.S. Published Patent Application No. 20070260248, an adjustable feature is incorporated into the screw allowing extension of the shaft length along a predetermined range. The screw has an outer member and an inner member connected together by a spring-like component. Once the shaft length is selected and the device is stabilized in said position, the device is inserted into the prepared canal of the femoral neck to fixate the bone segments, just as previously described for cannulated screws, in order to promote healing.

[0005] Other prior art include an intramedullary nail described as an adjustable solution for long bone fixation in U.S. Pat. No. 6,524,313. However, no prior art device has shown adjustable screw solutions for this regard. Therefore, there is a need in the art for an extendable screw system for surgical fixation of femoral neck fractures in pediatric patients.

[0006] Given the present design of cannulated screws used for the fixation of femoral neck fractures, including Slipped Capital Femoral Epiphysis, the compressive loads created by the medially threaded shafts and the lateral spherical screw heads inhibit the normal growth in young patients. Premature closure of the physeal plate is a reoccurring condition widely documented in the literature as a result of pinning and fixation via cannulated screws. Telescoping devices such as the Fassier-Duval Intramedullary Nail, whose fixation features do not thread into the physeal plate, have shown successful internal fixation of fractures and osteotomies in long bones without compromising the integrity of the physeal plate and thus allowing the continuation of normal patient growth.

SUMMARY

[0007] In one aspect, a cannulated screw assembly is provided that is self-extendable in length for surgical fixation of fractured femoral necks or slipped femoral epiphysis in a young patient.

[0008] In another aspect, a cannulated screw assembly is provided which requires minimally invasive instrumentation and a relatively straightforward surgical technique.

[0009] Hence, in accordance with one aspect of the screw assembly, a screw assembly for fixation of femoral neck fractures may include a telescopic assembly having two opposed ends and including a male component and a female component. The interconnected components permit axial movement of each end relative to each other. Anchorage of the female and male components is achieved through screw-type fixation of each end of the telescoping screw to the lateral cortex of the femur and the head of the femur. The smooth shaft design and lack of compression element allow free longitudinal extension of the length of the screw so that the screw is extendable as the bone heals and normal patient growth occurs.

[0010] According to one embodiment of the screw assembly with a beveled head design, the screw assembly is provided with an elongated tube having one end formed with an external self-tapping thread that has a diameter greater than the external diameter of the tube, and a cannulated rod having one end formed with an external self-tapping thread as large as the external diameter of the tube. The cannulated rod is adapted for insertion through a drilled canal into the bone until the self-tapping end is anchored in the medial end of bone (the epiphysis of the femoral head) and the rod spans the fracture site. The elongated tube is adapted for insertion into the bone, over the cannulated rod, until the external fixation thread at the lateral end of the tube is anchored within the lateral cortex of the bone. The screw assembly creates a stable fixation and inhibits radial displacements of the fractured segments of the bone while permitting longitudinal extendibility as the bone structures heals and normal patient growth occurs.

[0011] This embodiment of the screw assembly provides a relatively easy method of implantation because anchorage of the screw assembly is as would be anchorage of a single cannulated screw, wherein the action is achieved through rotating the respective rod and tube components until the threads anchor in the bone structures with the use of detachable driving tools. The position of the screw assembly is final when beveled head is parallel to surface of the lateral cortex.

[0012] According to another embodiment with a triblobe design, the screw assembly is provided with a male component with an elongated rod having one end formed with an external self-tapping thread that has a diameter greater than the external diameter of the tube, and a female component having one end formed with an external self-tapping thread that is the same diameter as the tube. The female component is adapted to be inserted through a drilled canal into the bone until the self-tapping end is anchored in the medial end of bone (the epiphysis of the femoral head) and the rod spans the fracture site. The male component is adapted to be inserted into the bone, inside the female component, until the external fixation thread at the lateral end of the rod is anchored within the lateral cortex of the bone.

[0013] An additional characteristic of this embodiment is to provide a cannulated screw assembly for surgical fixation of fractures bones which prevents rotational instability of the femoral epiphysis by preventing the rotation of the male and female components along the central axis. Rotation is hindered by interlocking of a non-circular feature (e.g. one or more flat surfaces, trilobe, cloverleaf, etc.) on the outer surface of the male component and the inner surface of the female component. The male component must be placed into the female component according to the specific mating pattern dictated by the interlocking feature on the components of the assembly. The screw assembly inhibits both radial displacements of the fractured segments of the bone and axial rotation of the segments around the axis of the screw assembly, while permitting longitudinal extendibility as the bone structures heal and normal patient growth occurs.

[0014] Moreover, the screw assembly provides a relatively easy method of implantation because the design allows anchorage of the screw assembly as would the anchorage of a single cannulated screw. The male and female components are assembled as per presented in the embodiment in order to screw in simultaneously both medial and lateral threading through a simple continuous rotation action with the use of a driving tool detachably connected to the male component, which in turn serves as the driving tool for the female component. Device position is final when all threads on tube have fully tapped into bone beyond the physeal plate within the femoral epiphysis.

[0015] In all embodiments, the screw assembly has a unique feature of self-adjustment in length after its implantation to provide a stable fixation of the fractured bone segments without the use of compressive forces to promote healing without disrupting normal patient growth, which is particularly advantageous when the screw assembly is used in children. In addition, rotational stability can be achieved by the incorporation of a non-circular design feature to block rotation between male and female components. Furthermore, retrieval features incorporated into the lateral ends of the embodiments of the present invention allow retention of the screws during insertion and removal procedures. Finally, a cap-like component completes the screw assembly, which inserts into the proximal end of the screw assembly at the lateral cortex in order to prevent bone in-growth for eased retrieval of the screw assembly once the fracture site is healed or patient growth is complete.

[0016] Additional objectives, advantages and novel features will be set forth in the description which follows or will become apparent to those skilled in the art upon examination of the drawings and detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a perspective view of a first embodiment of a screw assembly having a trilobe configuration;

[0018] FIG. **2** is a side view of the screw assembly;

[0019] FIG. **3** is an exploded view of the screw assembly showing the female component, male component and cap;

[0020] FIG. **3**A is an end view of the male component;

[0021] FIG. **4** is partially exploded side view of the screw assembly with the male component, female component, and cap;

[0022] FIG. **5** is a perspective view of the female component;

[0023] FIG. **5**A is a cross-sectional view along line **5**A-**5**A of FIG. **5**;

[0024] FIG. **6** is a side view of the female component;

[0025] FIG. **7** is a perspective view of the male component

[0026] FIG. **7**A is a cross-sectional view along line **7**A-**7**A of FIG. **7**;

[0027] FIG. **8** is a side view of the male component;

[0028] FIGS. **9**A and **9**B are perspective views of the cap;

[0029] FIG. **10** is a perspective view of a second embodiment of the screw assembly having a double flat configuration;

[0030] FIG. **11** is a side view of the screw assembly shown in FIG. **10**;

[0031] FIG. **12** is an exploded view of the screw assembly shown in FIG. **10** illustrating the female component, male component and cap;

[0032] FIG. **12**A is an end view of the male component shown in FIG. **12**;

[0033] FIG. **13** is a partially exploded side view of the screw assembly shown in FIG. **10** with the male component, female component, and cap;

[0034] FIG. **14** is a perspective view of the female component shown in FIG. **10**;

[0035] FIG. **14**A is a cross-sectional view taken along line **14**A-**14**A of FIG. **14**.

[0036] FIG. **15** is a side view of the female component shown in FIG. **10**;

[0037] FIG. **16** is a perspective view of the male component shown in FIG. **10**;

[0038] FIG. **16**A is a cross-sectional view of the male component along line **16**A-**16**A of FIG. **16**;

[0039] FIG. **17** is a side view of the male component shown in FIG. **10**;

[0040] FIG. **18** is a perspective of a third embodiment of the screw assembly having a beveled head configuration;

[0041] FIG. **19** is a side view of the screw assembly shown in FIG. **18**;

[0042] FIG. **20** is an exploded view of the screw assembly shown in FIG. **18**

[0043] FIG. **21** is a partially exploded side view of the screw assembly shown in FIG. **18** with the male component and female component;

[0044] FIG. **22** is a perspective view of the female component shown in FIG. **18**;

[0045] FIG. **22**A is a cross-sectional view taken along line **22**A-**22**A of FIG. **22**;

[0046] FIG. **23** is a side view of the female component shown in FIG. **18**;

[0047] FIG. **24** is a perspective view of the male component shown in FIG. **18**;

[0048] FIG. **24**A is a cross-sectional view taken along line **24**A-**24**A of FIG. **24**; and

[0049] FIG. **25** is a side view of the male component shown in FIG. **18**;

[0050] FIGS. **26**A-**26**G illustrate one method for using the screw assembly shown in FIG. **1**.

[0051] Corresponding reference characters indicate corresponding elements among the view of the drawings. The headings used in the figures should not be interpreted to limit the scope of the claims.

DETAILED DESCRIPTION

[0052] Referring to the drawings, various embodiments of the screw assembly are illustrated and generally indicated as **100**, **200** and **300** in FIGS. **1-25**.

[0053] In one embodiment shown in FIGS. **1-9**, the screw assembly, designated **100**, may include a hollow female component **102** configured to receive a male component **104** with a cap **105** that engages one end of the male component **104**. Specifically, the male component **104** is freely slidable relative to female component **102** along longitudinal axis **900** (FIG. **1**), which allows the screw assembly **100** to lengthen over time along axis **900** and accommodate the natural growth of the growth plate as the fracture heals over a period of time.

[0054] Referring to FIGS. **1** and **4**, the female component **102** defines circular-shaped hollow shaft **107** that defines an elongated trilobe-shaped channel **118** therein configured to accommodate a trilobe-shaped shaft **106** of the male component **104** such that the trilobe-shaped shaft **106** of the male component **104** may freely slide relative to the elongated trilobe-shaped channel **118** of the female component **102**.

[0055] Referring to FIGS. **5** and **5**A, the circular-shaped hollow shaft **107** of the female component **102** further defines a proximal end opening **110** in communication with the elongated trilobe-shaped channel **118**. In addition, the female component **102** further include a medial threaded portion **108**, having a cancellous profile, that defines an axial opening **111** in communication with an interior cannulated section **114**. The other end of the interior cannulated section **114** is in communication with the far end of the elongated trilobe-shaped channel **118** such that fluid flow communication is established between the axial opening **111** and the proximal end opening **110**. In one embodiment, the inner diameter of the cannulated section **114** is less than the inner diameter of the elongated trilobe-shaped channel **118**. As shown, one embodiment of the medial threaded portion **108** may define a self-tapping cut-out feature **121** that facilitates entry of the female component **102** into the bone as shall be described in greater detail below. As further shown, an internal threaded portion **112** is defined adjacent to the proximal end opening **110** for engaging with a removal device (not shown) with matching thread.

[0056] As shown in FIGS. **7**, **7**A and **8**, the male component **104** includes a trilobe-shaped shaft **106** having a substantially three-sided cross-sectional configuration sized and shaped to be disposed within the elongated trilobe-shaped channel **118** when the male component **104** is engaged to the female component **102**. The male component **104** defines a far end opening **113** along a trilobe-shaped end **136** of the elongated trilobe-shaped shaft **106** and a lateral threaded portion **116** at the opposite end of the elongated trilobe-shaped shaft **106**. The lateral threaded portion **116** features a flat head configuration at the free end thereof that positions the lateral threaded portion **116**, whose diameter is larger than the trilobe-shaped shaft **106**. In addition, the lateral threaded portion **116** defines a self-tapping feature **120** formed along the lateral threaded portion **116**.

[0057] As shown in FIG. **7**A, the far end opening **113** is in communication with a cannulated section **119** which forms a channel along the length of the elongated trilobe-shaped shaft **106**. In addition, a drive feature **122** communicates with the opposite end of the cannulate section **119** through an internal threaded section **115** formed adjacent the drive feature **122**, whose combination is used to retain and drive the assembled male and female components simultaneously into the bone (FIG. **26**A).

[0058] Referring to FIG. **3**A, the trilobe-shaped shaft **106** includes a first trilobe portion **130**, a second trilobe portion **132**, and a third trilobe portion **134** that collectively form a non-cylindrical cross-sectional configuration that prevents rotation of the female component **102** relative to the male component **104**. As noted above, the trilobe-shaped shaped shaft **106** is freely slidable along longitudinal axis **900** of the screw assembly **100**, while the non-circular shape of the trilobe-shaped shaft **106** prevents rotational movement of the female component **102** relative to the male component **104** along rotational direction **902** (e.g. in either the clockwise or counter-clockwise rotational directions). Although the embodiment of the male component **104** shown in FIGS. **1-8** defines a three-sided trilobe-shaped cross-sectional configuration, other types of non-cylindrical cross-sectional configurations may be used to define the shaft **106**, such as triangular, square, rectangular, or oblong-shaped cross-sectional configurations that allows sliding movement of the male component **104**, but prevents rotational movement of the female component **102** relative to the male component **104**. In this mating engagement between the female component **102** and the male component **104**, the drive mechanism **10** is able to drive both female and male components **102** and **104** into the bone.

[0059] Referring to FIGS. **9**A and **9**B, the cap **105** may be used to seal off the recessed drive feature **122** of the male component **104**. As shown, the cap **105** includes a semi-spherical shaped cap portion **126** that defines a recess **125** configured to connect with a drive and removal tool **11** with a matching profile. The cap portion **126** communicates with a cylindrical-shaped middle portion **128** with an external threaded portion **124** that extends axially from the middle portion **128**. As shown in FIG. **4**, the external threaded portion **124** of the cap **105** is configured to engage and retain the proximal end internal threads **115** defined by the male component **104**.

[0060] During manufacture, the following dimensions may be used for one embodiment of the screw assembly **100**, although other suitable dimensions may be used for other embodiments. Referring to FIGS. **2** and **6**, the screw assembly **100** may have a length **500** of between 60 mm to 102 mm in 2 mm increments, while the female component **102** may have a length **502** of between 52 mm to 92 mm in 4 mm increments and a width **504** of 6.5 mm to 7.3 mm. As shown in FIG. **8**, the male component **104** may have a length **506** of between 48 mm to 50 mm and a width **508** at the head **508** of between 8.0 mm to 9.0 mm.

[0061] In a second embodiment shown in FIGS. **10-17**, the screw assembly, designated **200**, may include a hollow female component **202** configured to receive a male component **204** with a cap **205** that engages the male component **204** in similar fashion as cap **105**. As shown in FIG. **12**A, the male component **204** includes a double flat shaped shaft **206** having opposing sides **232** and **236** as well as opposing sides **230** and **234** that collectively define either a generally squared-shaped or rectangular-shaped cross sectional configuration. Similar to screw assembly **100**, the non-cylindrical shape of the double flat shaped shaft **206** for the male component **204** functions in a similar manner as the trilobe-shaped shaft **106** of male component **104** to prevent rotational movement **906** of the female component **202** relative to the male component

204 while allowing free sliding movement along longitudinal axis **904** of the screw assembly **200**.

[0062] Referring to FIGS. **14** and **15**, the female component **202** includes a cylindrically-shaped elongated hollow body **207** having a proximal end opening **210** at one end and an external threaded portion **208** at the opposite end thereof. In one embodiment, the external threaded portion **208** may have a cancellous-shaped profile having a diameter substantially equivalent to the diameter of the cylindrically-shaped elongated hollow body **207** for providing increased mechanical properties under weight bearing conditions. In addition, the external threaded portion **208** includes a self-tapping feature **221** that facilitates entry of the female component **102** into the bone and an axial opening **211**.

[0063] As shown in FIG. **13**, the axial opening **211** is in communication with a cannulated section **214** formed through the external threaded portion **208** of the female component **202**. In addition, the cannulated section **214** is in communication with an elongated channel **218** formed through the cylindrically-shaped elongated hollow body **207** that is configured to receive the male component **204** therein. In one embodiment, the elongated channel **218** defines a double-sided cross sectional configuration having the same cross sectional configuration as the double sided-shaped shaft **206**. As further shown, a left handed internal threaded section **212** is formed proximate the proximal end opening **210** and is configured to mate with a removal instrument (not shown) for ease of retrieval of the female component **202**.

[0064] Referring to FIGS. **13**, **16**, **16**A and **17**, the male component **204** defines a medial threaded portion **216** having a flat head with a self tapping feature **220** formed along the medial threaded portion **216**. In one embodiment, a drive feature **222** forms a hexagonal-shaped recess in communication with a proximal end internal threaded portion **215** configured to engage an external threaded portion **224** of the cap **205** when the cap **205** is engaged into the male component **204**. The combination of the drive feature **222** and the internal threaded portion **215** is used to retain and drive the assembled male and female components **202** and **204** into the bone (FIG. **26**A). In addition, the male component **204** includes an axial opening **213** in communication with cannulated section **219** that forms an elongated channel between the axial opening and the drive feature **222**. As shown, the cap **205** is similar in construction as cap **105** having a middle portion **228** in communication with a cap portion **226** having a recess **225**.

[0065] During manufacture, the following dimensions may be used for one embodiment of the screw assembly **200**, although other suitable dimensions may be used for other embodiments. Referring to FIG. **11**, the screw assembly **200** may have a length **700** of between 60 mm to 102 mm in 2 mm increments. As shown in FIG. **15**, the female component **202** may have a length **702** of between 50 mm to 90 mm in 4 mm increments and a width **704** of between 6.5 mm and 7.3 mm. As shown in FIG. **17**, the male component **204** may have a length **706** of between 48 mm to 50 mm and a width **708** of between 8.0 mm to 9.0 mm

[0066] In a third embodiment shown in FIGS. **18**-**25**, the screw assembly, designated **300**, may include a hollow female component **302** configured to receive a male component **304**. As shown in FIGS. **22**, **22**A, and **23**, the female component **302** defines a hollow cylindrical shaft portion **306** having a far end opening **310** formed at one end and a lateral beveled end portion **308** at the opposite end thereof. The hollow cylindrical shaft portion **306** allows for ease of insertion of the screw assembly **300** into the bone and eliminates disruption of the physeal plate as not sharp features are inserted into the physeal plate. The far end opening **310** is in communication with an elongated channel **320** formed along the cylindrical shaft portion **306**.

[0067] As shown in FIG. **22**A, an internal drive feature **322** is formed at the proximal end inside the lateral beveled end portion **308** and forms a hexagon-shaped recess. The drive feature **322** is configured to receive a portion of the drive mechanism **10** (FIG. **26**A) for insertion through a bone. As further shown, a left-handed internal threaded portion **324** is formed between the drive feature **322** and a cannulated section **326**. The left-handed internal threaded portion **324** facilitates retention of the screw assembly **300** for ease of removal, while the cannulated section **326** for guided insertion of the component into the bone using a cannulated rod (not shown). The lateral beveled end portion **308** has a diameter larger than the hollow shaft portion **306** for better retention of the screw assembly **300** in the bone.

[0068] Referring to FIG. **19**, the lateral beveled end portion **308** defines a beveled profile that positions the cortical profiled threads of the lateral beveled end portion **308** fully within the lateral cortex, flush against the bone surface, thereby eliminating exposure of the threads outside the bone.

[0069] As shown in FIGS. **20**, **24**, **24**A, and **25**, the male component **304** defines a hollow cylindrical shaft portion **307** with a medial threaded portion **316** having a cancellous profile formed at one end of the shaft portion **307** and an external drive feature **312** formed at the opposite end thereof. The medial threaded portion **316** defines a self-tapping feature **318** that facilitates entry of the male component **304** into the bone. In some embodiments, the medial threaded portion **316** has a diameter larger than the diameter of the cylindrical shaft **307**. As shown, an axial opening **313** is formed proximate the medial threaded portion **316** and is in communication with an elongated channel **325** at one end thereof. The external drive feature **312** forms an opening **315** that communicates with the opposite end of the elongated channel **325**. As such, the male component **304** is fully cannulated to insert over a standard guide wire (not shown). In addition, the hollow cylindrical shaft portion **307** defines a left-handed retrieval threaded section **314** formed proximate the external drive feature **312**.

[0070] As shown in FIG. **20**, the male component **304** may freely slide relative to the female component **302**. In this embodiment, no cap is required to be engaged to the male component **304**.

[0071] During manufacture, the following dimensions may be used for one embodiment of the screw assembly **300**, although other suitable dimensions may be used for other embodiments. Referring to FIG. **19**, the screw assembly **300** may have a length **800** of between 60 mm to 100 mm in 2 mm increments. As shown in FIG. **23**, the female component **302** may have a length **802** of between 50 mm to 80 mm in 4 mm increments and a width **804** at the shaft of between 8.0 mm to 9.0 mm. As shown in FIG. **25**, the male component **304** may have a length **806** of 50 mm, a width **808** at the shaft of between 5.0 mm and 5.8 mm and a width **808** at the head of between 6.5 mm to 7.3 mm.

[0072] Referring to FIGS. **26**A-**26**G, one method of using the screw assemblies **100** and **200** is illustrated. However, for ease of description only the use of screw assembly **100** will be described herein since the method of use is the same for both embodiments. Referring to FIGS. **26**A-**26**C, the male component **104** received within the female component **102** is inserted through the physeal plate using a drive mechanism **10** until the lateral threaded portion **116** of the male component **104** is fully disposed within the lateral cortex. In this arrangement, the male component **104** is fully received within the female component **102** such that the cylindrical shaft **106** is fully disposed within the female component **102**. As shown in FIGS. **26**D-**26**F, the cap **105** is attached to the lateral threaded portion **116** using the driving mechanism **11** which seals off both the male component **104** and female component **102** within the lateral cortex. As shown in FIG. **26**G, the free sliding engagement between the female component **102** and the male component **104** allows the cylindrical shaft **106** to gradually extend from the female component **102** as the physeal plate grows over time as the fracture heals.

[0073] It should be understood from the foregoing that, while particular embodiments have been illustrated and described, various modifications can be made thereto without departing from the spirit and scope of the invention as will be apparent to those skilled in the art. Such changes and modifications are within the scope and teachings of this invention as defined in the claims appended hereto.

What is claimed is:

1. A screw assembly comprising:

a female component including a hollow elongated shaft defining a medial threaded portion at one end of the hollow shaft and a lateral end opening at the opposite end thereof, wherein the lateral end opening is in communication with a non-cylindrically shaped channel formed along the hollow shaft;

a male component configured to be received within the non-cylindrically shaped channel of the female component, the male component including a non-cylindrical shaped shaft defining a lateral threaded portion at one end; and

a cap configured to engage the male component;

wherein the non-cylindrical shaped channel of the female component defines substantially the same cross-sectional configuration as the non-cylindrical shaped shaft of the male component such that the male component is freely slidable relative to the female component along a longitudinal axis defined by the screw assembly.

2. The screw assembly of claim **1**, wherein the male component is not rotatable relative to the female component when the female component is engaged to the male component.

3. The screw assembly of claim **1**, wherein the non-cylindrical shaped shaft of the male component and the non-cylindrical shaped channel of the female component each have a three sided cross sectional configuration or a double flat cross-sectional configuration.

4. The screw assembly of claim **1**, wherein the non-cylindrical shaped shaft of the male component and the non-cylindrical shaped channel of the female component each have a triangular, square, rectangular, or oblong cross-sectional configurations.

5. The screw assembly of claim **1**, wherein the lateral threaded portion of the male component defines a cortical-shaped profile.

6. The screw assembly of claim **1**, wherein the medial threaded portion of the female component defines a cancellous-shaped profile.

7. The screw assembly of claim **1**, wherein the medial threaded portion of the female component includes a self-tapping feature defining a flat surface area.

8. The screw assembly of claim **1**, wherein a diameter of the medial threaded portion is as large as an external diameter of the hollow elongated shaft.

9. The screw assembly of claim **1**, wherein the male component further includes a drive feature defining a hexagonal-shaped recess formed proximate the lateral threaded portion.

10. The screw assembly of claim **9**, wherein the male component defines a second lateral threaded portion formed proximate the drive feature, wherein the second lateral threaded portion is configured to engage the cap and a drive mechanism.

11. The screw assembly of claim **1**, wherein the cap comprises a middle portion with a cap portion formed at one end of the middle portion and an external threaded portion formed at the opposite end thereof.

12. The screw assembly of claim **1**, wherein the lateral threaded portion of the male component includes a self-tapping feature that defines a flat surface area.

13. The screw assembly of claim **1**, wherein the medial threaded portion of the female component defines an axial opening in communication with the non-cylindrical shaped channel.

14. The screw assembly of claim **9**, further comprising a drive mechanism configured to engage the drive feature for inserting the screw assembly into a bone.

15. A screw assembly comprising:

a female component including a hollow elongated shaft defining a lateral threaded portion at one end of the elongated hollow shaft and a medial end opening at the opposite end thereof, wherein the medial end opening is in communication with a cylindrically shaped channel formed along the elongated hollow shaft; and

a male component configured to be received within the cylindrically shaped channel of the female component, the male component including a cylindrical shaped shaft defining a medial threaded portion at one end;

wherein the cylindrical shaped channel of the female component defines substantially the same cross-sectional configuration as the cylindrical shaped shaft of the male component such that the male component is freely slidable and rotatable relative to the female component along a longitudinal axis defined by the screw assembly.

16. The screw assembly of claim **15**, wherein the lateral threaded portion of the female component defines a beveled profile.

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