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(54) ORTHOPEDIC SCREW AND METHOD OF USE

(76) Inventors: **Joseph Ferrante**, Barlett, TN (US); **Angie Black**, Mason, TN (US)

Correspondence Address:
CHIEF PATENT COUNSEL
SMITH & NEPHEW, INC.
1450 BROOKS ROAD
MEMPHIS, TN 38116 (US)

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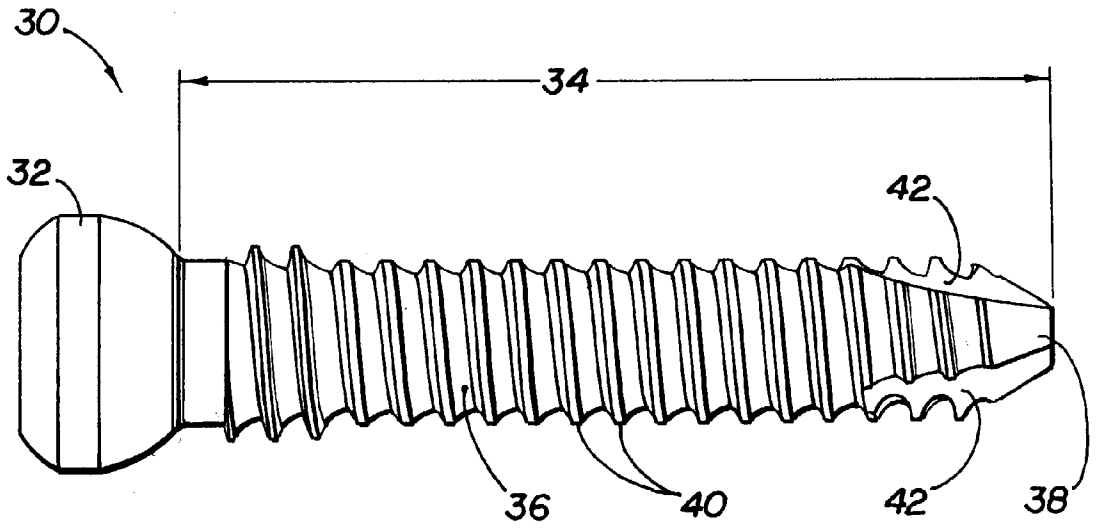
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(57) ABSTRACT

An orthopedic screw with a screw head, a screw body with distal tip, a shank with an enlarged diameter at the trailing end and a thread extending radially outward from the shank, and an internal capture surface; a system for use in an orthopedic surgical procedure including the screw, and orthopedic implant adapted to be secured in a patient with the screw, and a driver capable of engaging the internal capture of the screw; and methods of using the screw, the system, and the screw and driver assembly.



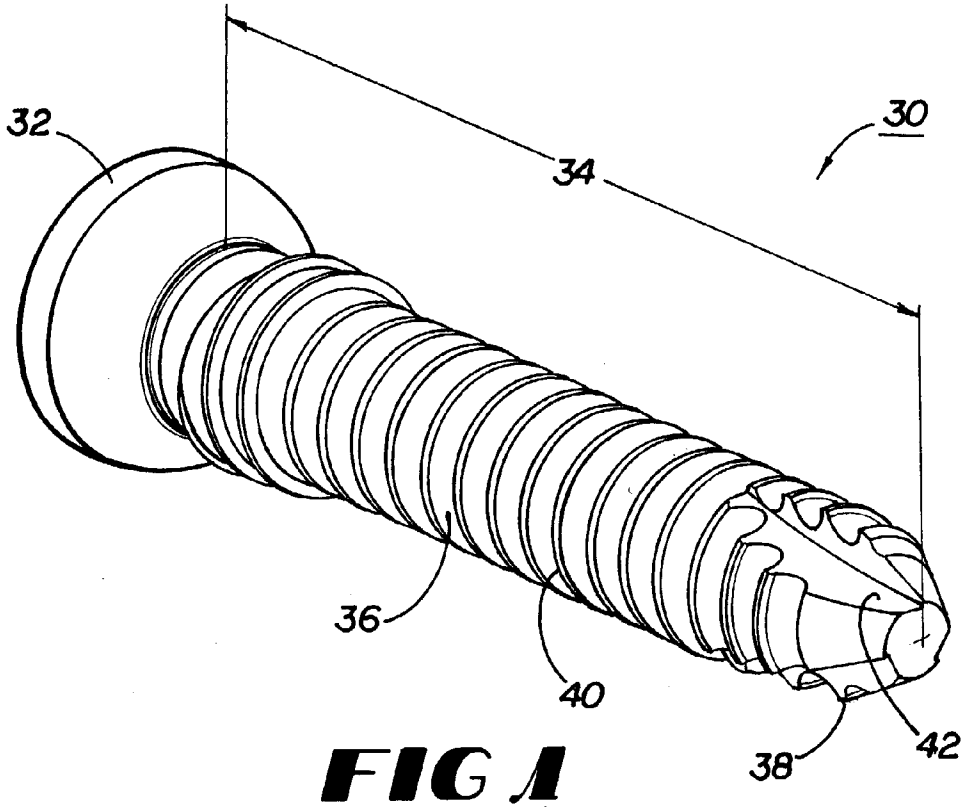


FIG 1

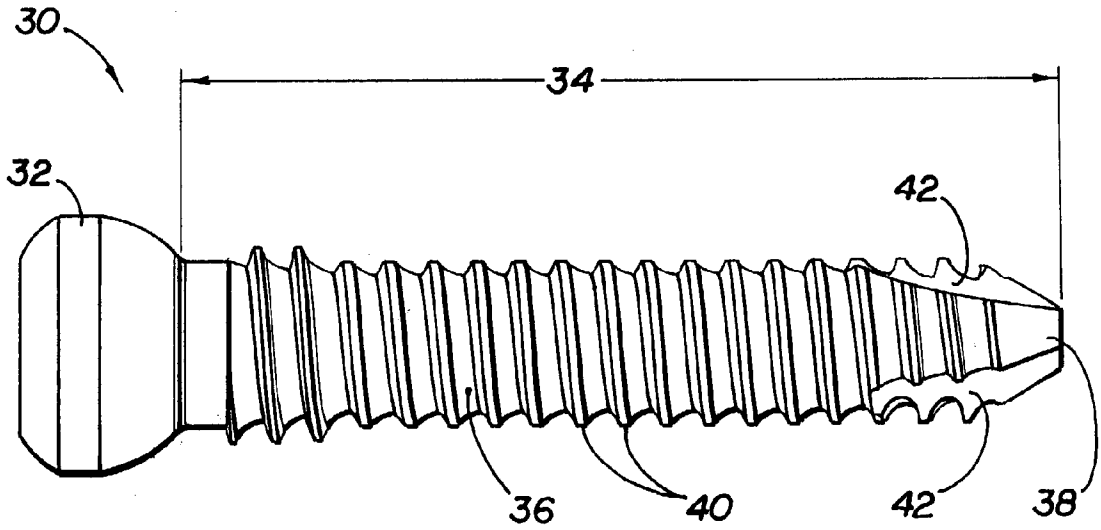


FIG 2

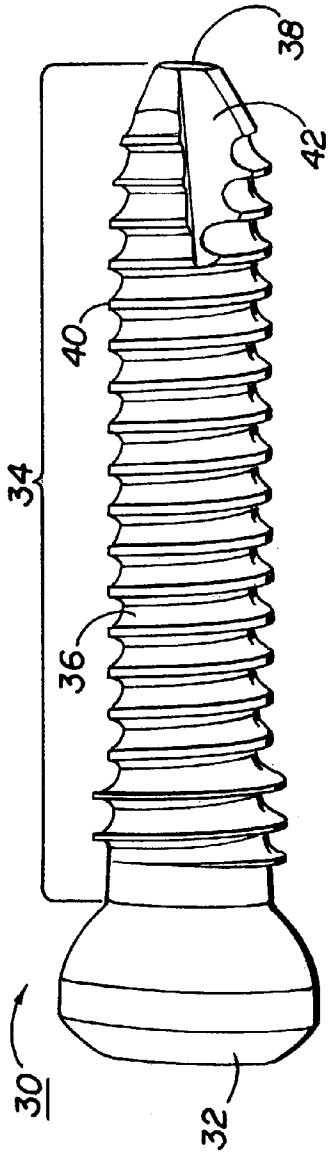

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FIG 3

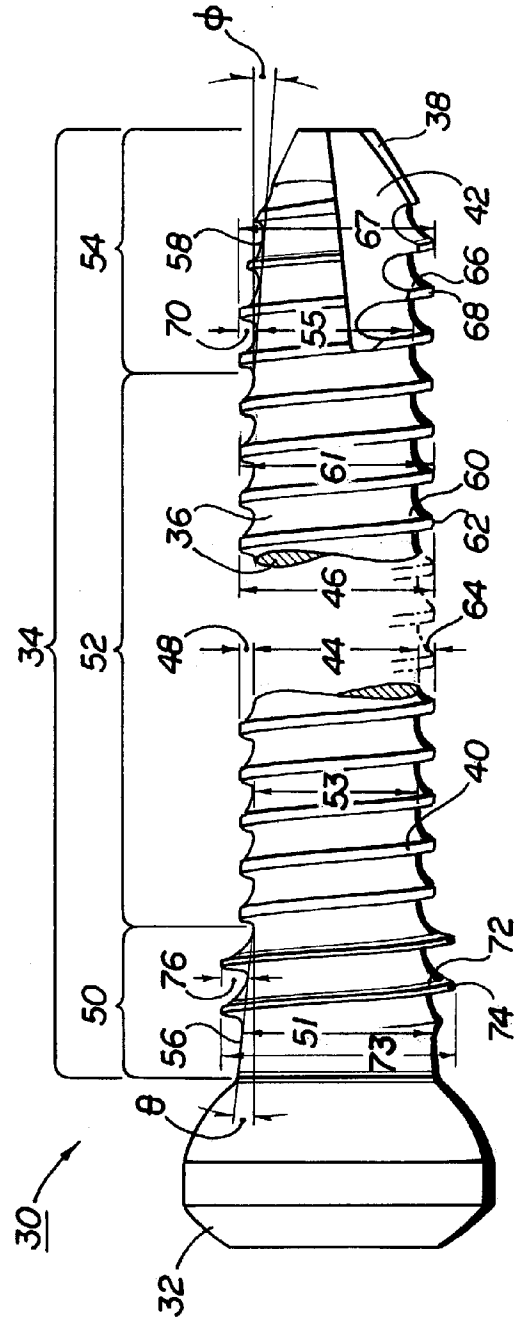

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FIG 4

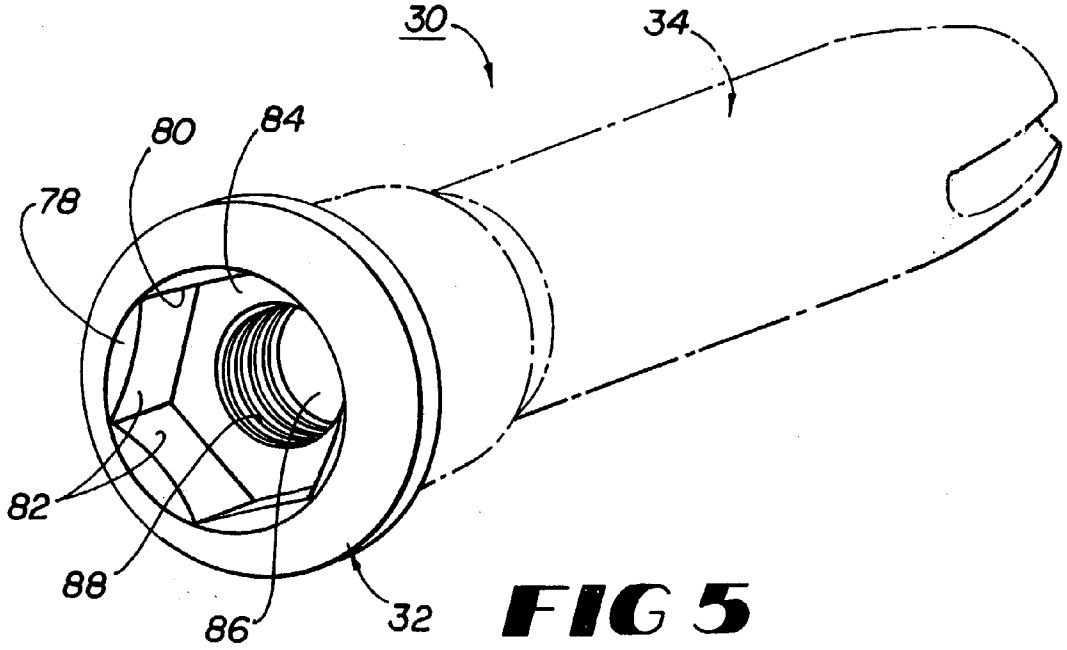


FIG 5

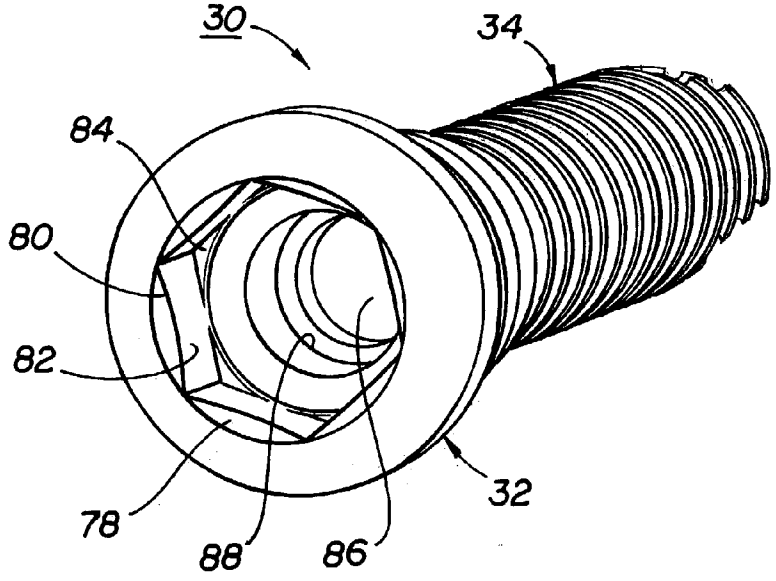


FIG 6

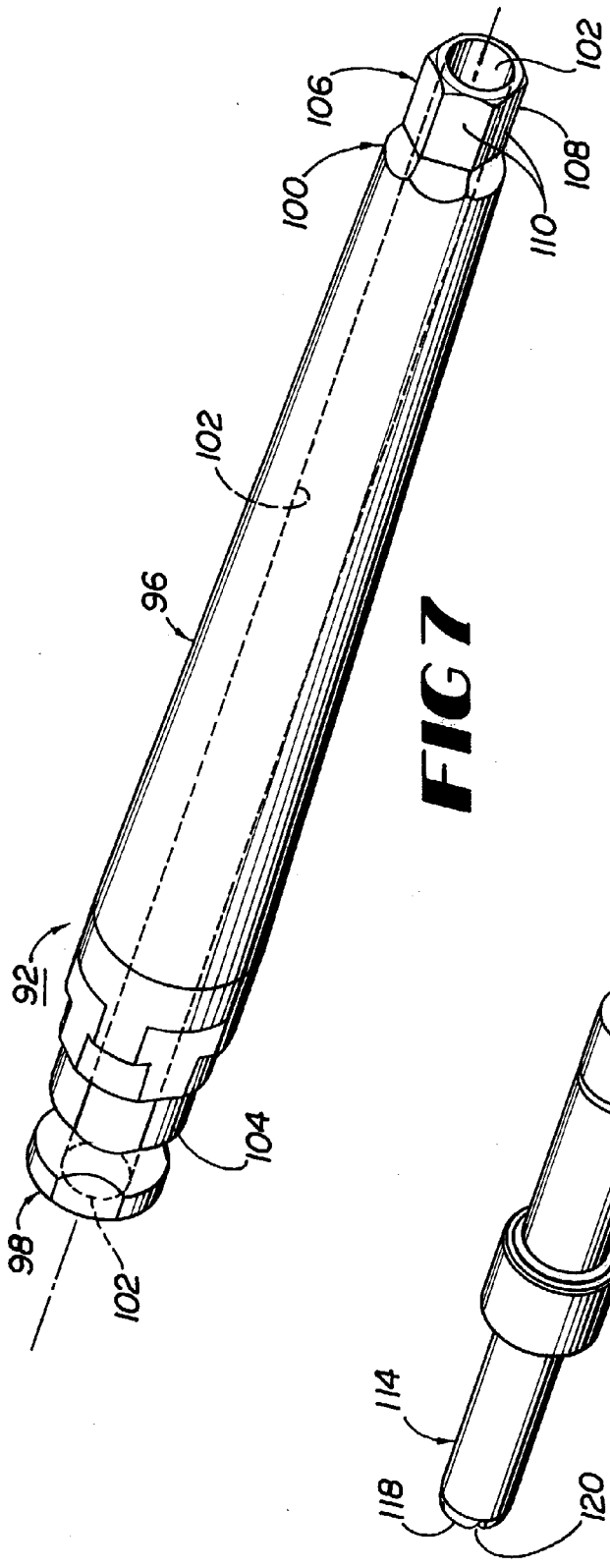

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FIG 7

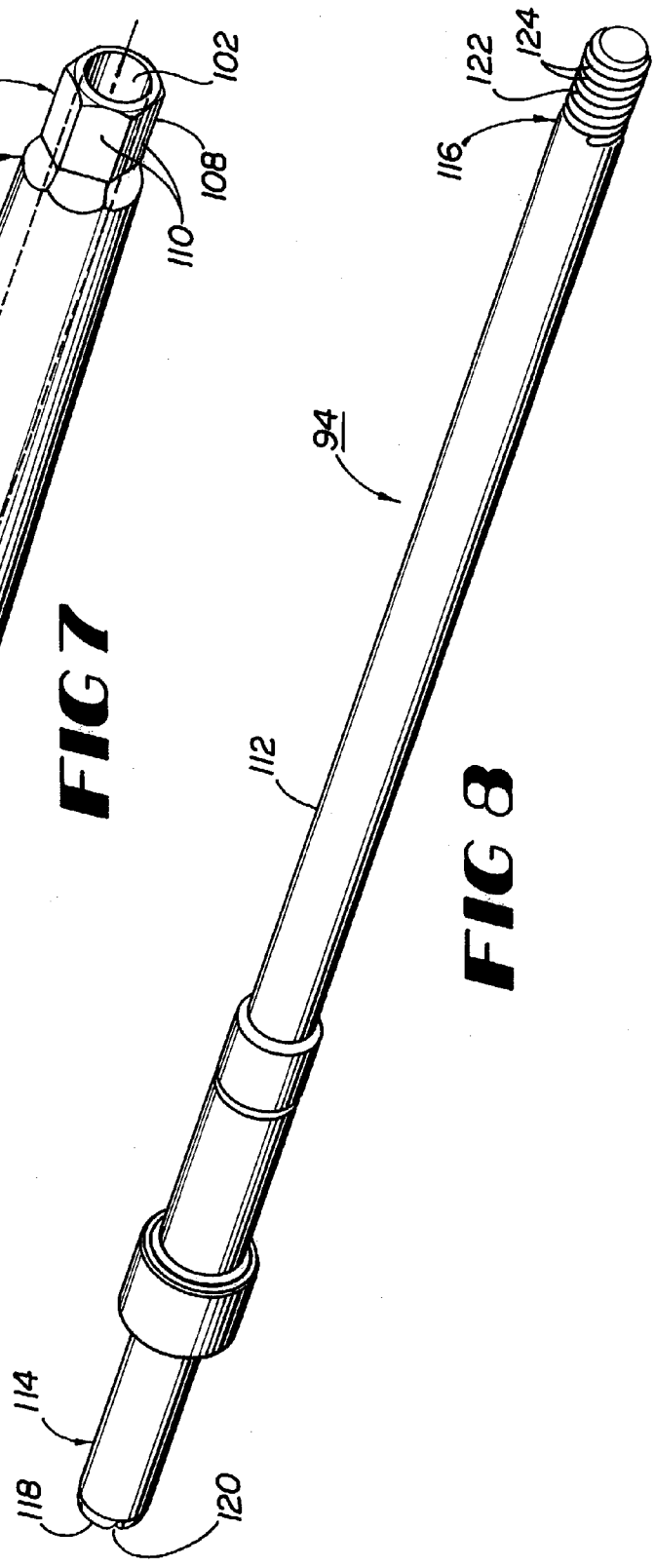

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FIG 8

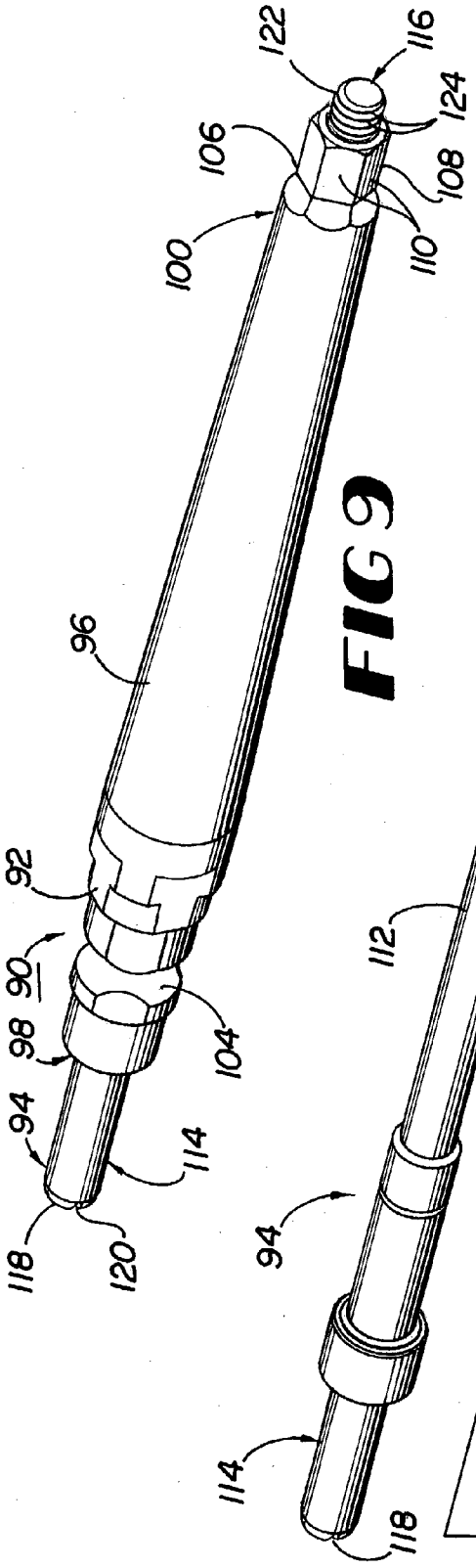

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FIG 9

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FIG 10

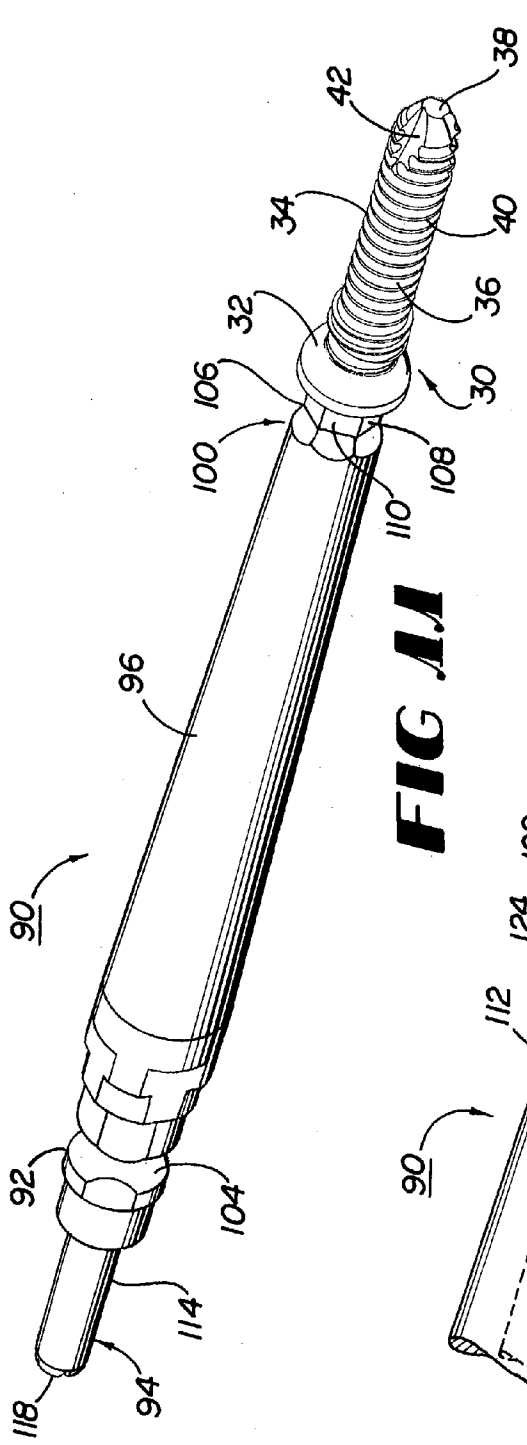

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FIG 11

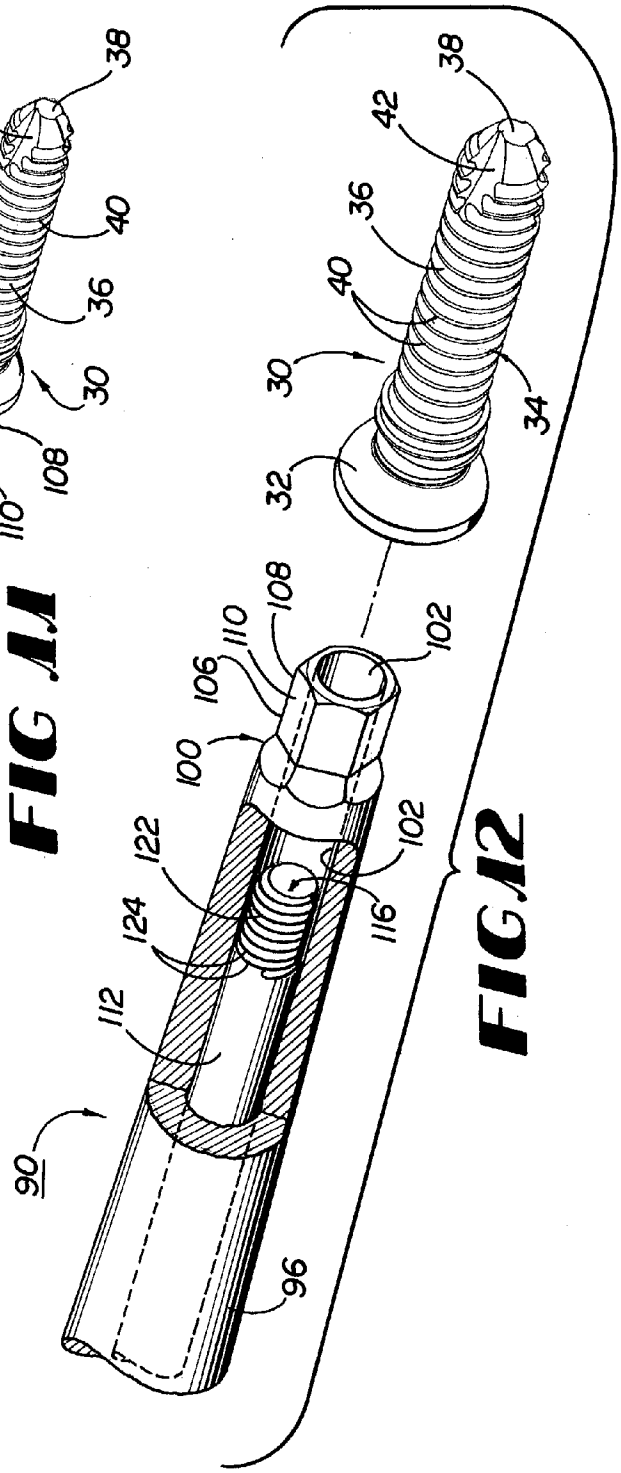

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FIG 12

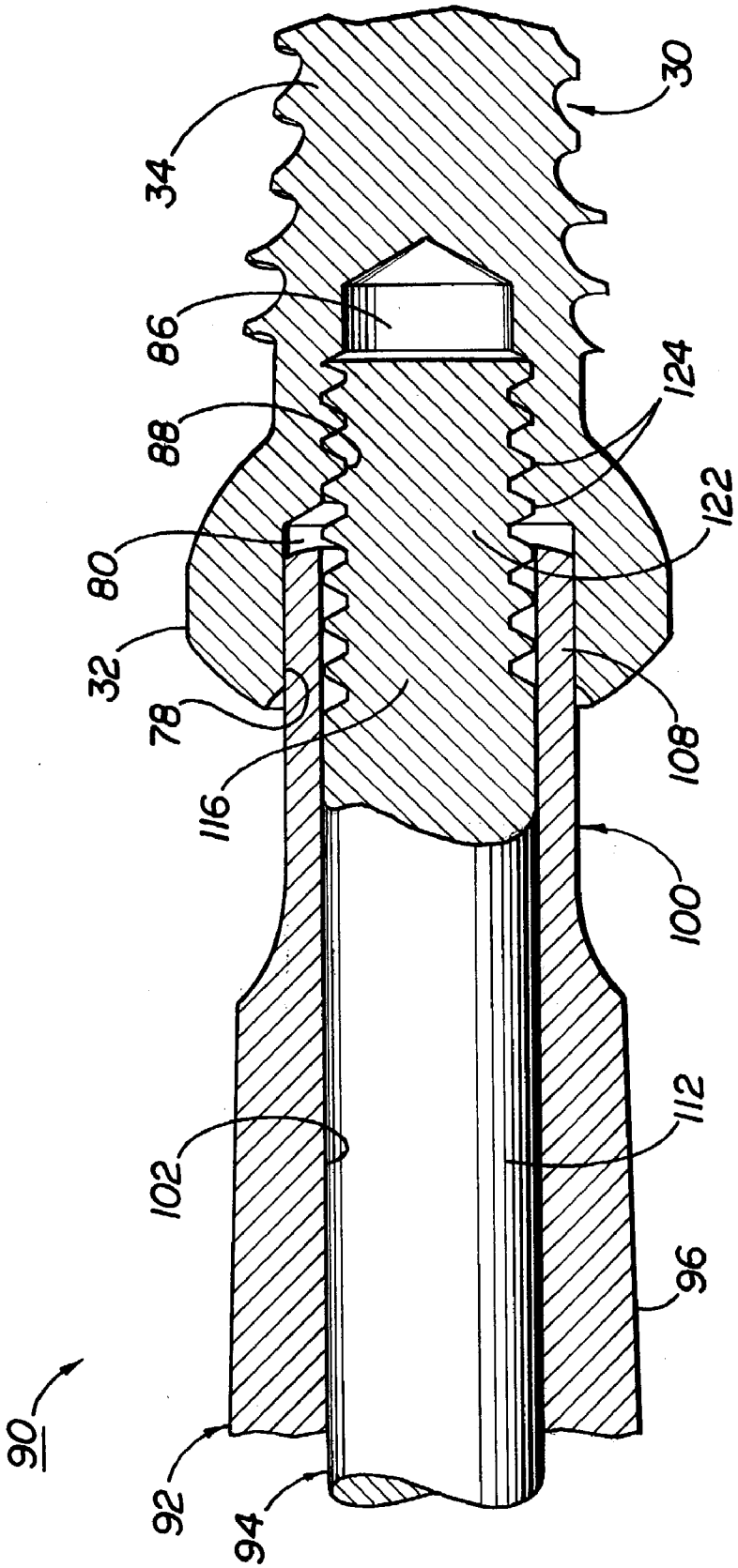


FIG 13

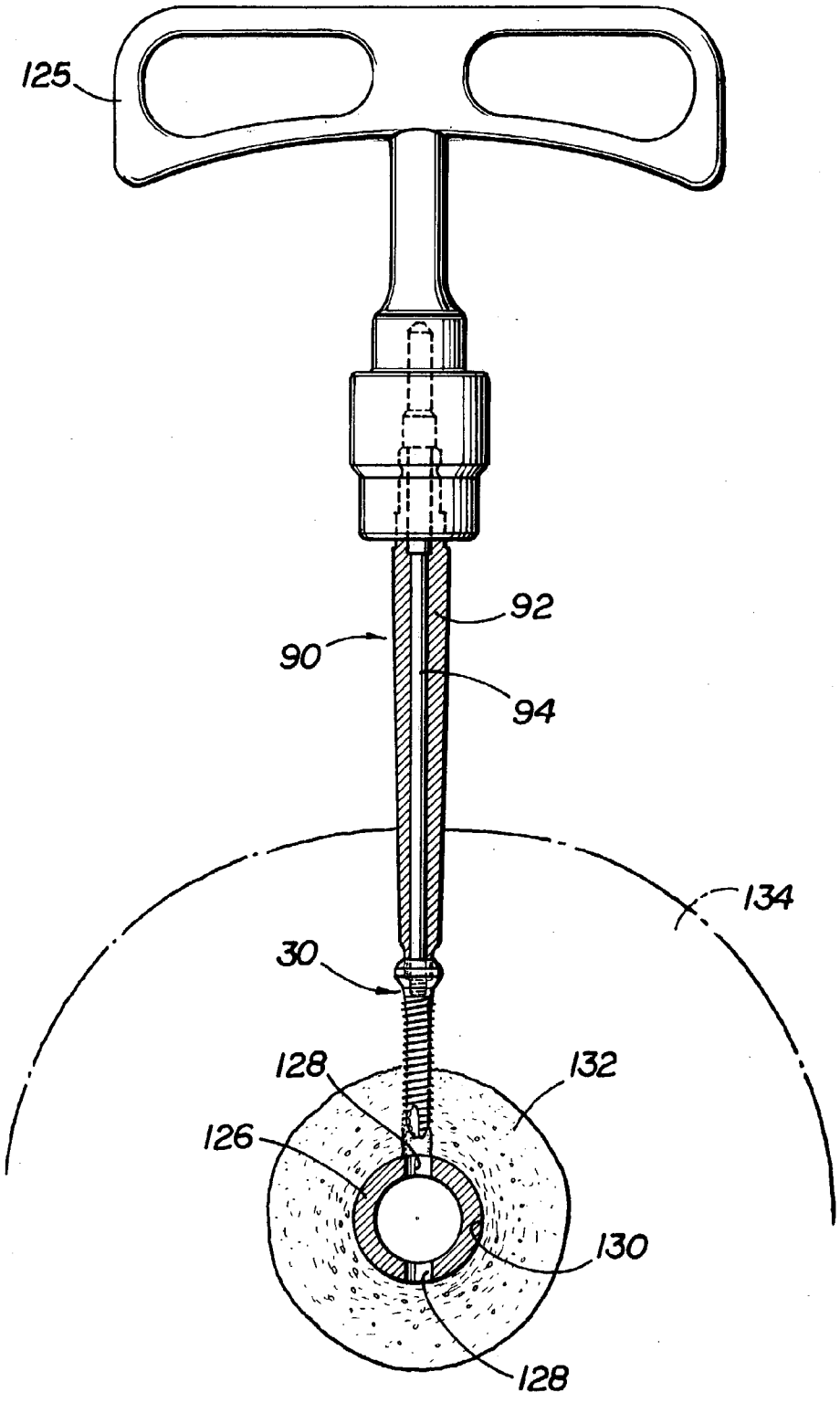


FIG 14

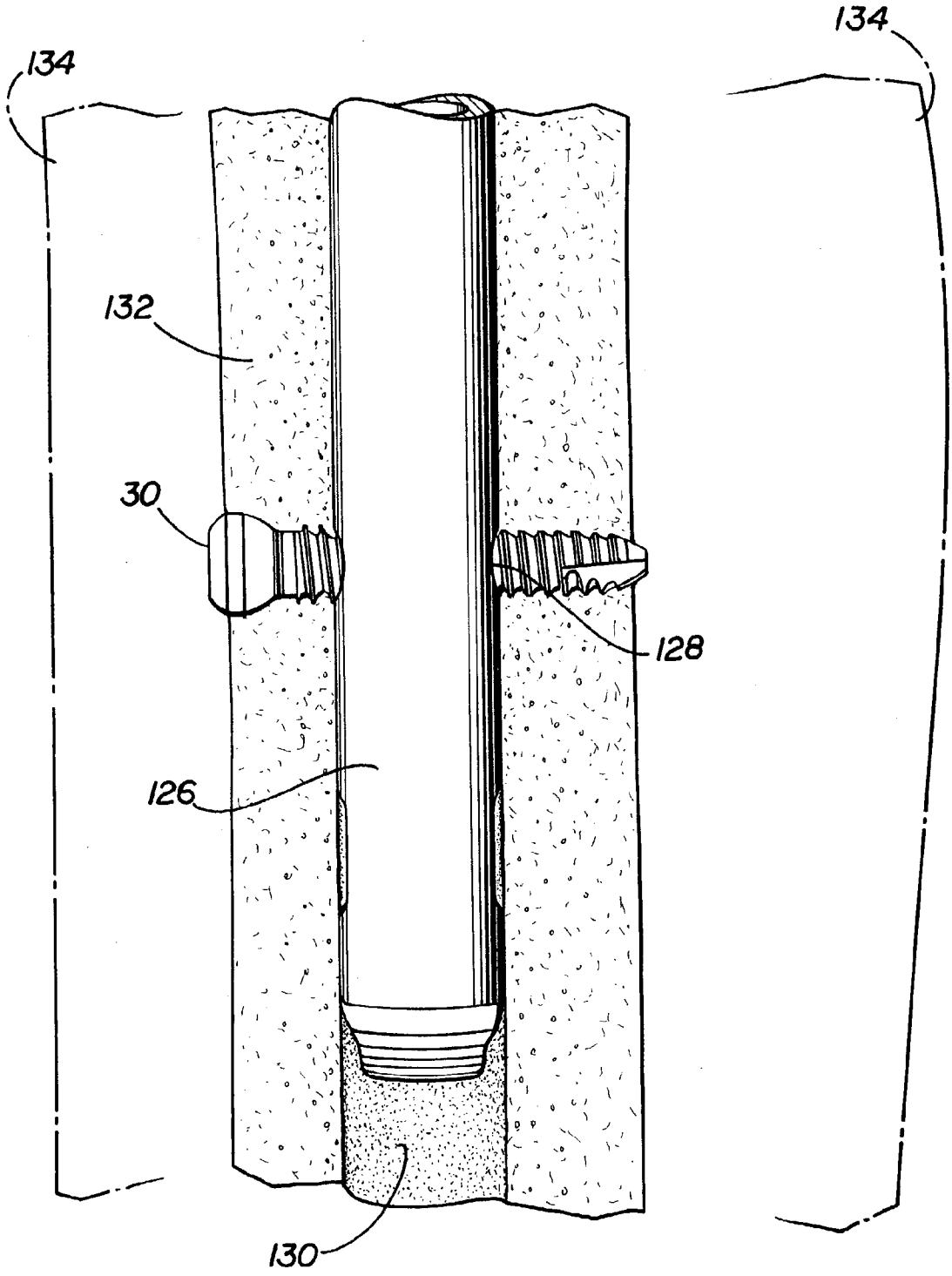


FIG 15

ORTHOPEDIC SCREW AND METHOD OF USE

FIELD OF THE INVENTION

[0001] This invention relates generally to methods, instrumentation and devices for use in a surgical procedure for the repair of bone fractures and the fixation of orthopedic implants. More particularly, this invention relates to methods, instrumentation and devices for securing an orthopedic implant, such as a bone fracture reduction rod, intramedullary nail, or other prosthetic device. This invention even more particularly relates to an improved orthopedic screw with an enlarged shank diameter at the trailing end of the screw and an internal capture surface recessed into the head and at least part of the trailing end, along with a driver capable of engaging the internal capture of the screw.

BACKGROUND OF THE INVENTION

[0002] Surgeons perform a variety of orthopedic procedures requiring screws specifically designed for use in bone tissue. A wide array of bone screws exist which are adapted to perform specific functions or to be compatible with a specific type of bone tissue or orthopedic implant.

[0003] For example, in order to stay a bone fracture, particularly in a long bone, a surgeon may insert a bone fracture reduction rod, or intramedullary nail, into an intramedullary canal of the bone. In order to secure the rod, the surgeon will place bone screws through holes in the intramedullary nails. Screws used for this purpose often extend through the bone and the hole in the nail and into the far cortex on the opposite side of the long bone. The use of such screws provides many advantages such as increasing the rotational stability of the implanted nail, enhancing the union rate of the bone, and promoting limb rehabilitation.

[0004] However, the use of such bone screws also presents certain challenges. For example, a surgeon often needs to have several drivers available during a procedure because a single nailing system typically employs a large number of different screws of various sizes. As a result, the surgeon may be required to exchange drivers in the middle of the procedure. Moreover, bone screws which are not secured to the driver during implantation can slip off and become lost within surrounding muscle tissue. Retrieval of these screws proves difficult when the bone area is surrounded by a large amount of soft tissue, such as in the areas adjacent the forearm and the proximal thigh, particularly in larger patients. The delay in retrieving the lost screw and other inconveniences and risks associated with the loss of screws during surgery are not only unnecessary, but can compromise the success of the procedure.

[0005] Therefore, in performing orthopedic surgery it is desirable for the bone screw to be coupled to a driver to allow attachment of the screw to the driver prior to implantation in the bone, in order to avoid losing the screw in the surrounding soft tissue during the procedure, and to allow release of the screw in a desired manner after implantation. Screw and driver combinations exist which allow axial attachment of the screw to a driver prior to insertion, after which the surgeon rotates the driver until the screw is fully implanted. After implantation, the driver is disengaged from the screw. However, although known screw and driver combinations help reduce the risk of screw loss, these previous capture mechanisms typically suffer from one or more problems which limit their utility and performance.

[0006] For instance, prior art screw and driver combinations exist which utilize an external capture mechanism, such as a geometrically shaped head for engaging a driver with a socket for receiving the shaped head. However, these mechanisms proved undesirable due to irritation of the surrounding soft tissue caused by the bulky heads. Additionally, often a surgeon desires to countersink the head of the screw into the bone so that the top of the head is flush with or beneath the bone surface to further avoid tissue irritation, but the heads of the external capture screws can not be appropriately countersunk. Other external capture mechanisms include drivers with chalk-holder type devices for grasping the head of the screw during implantation. Screws with smooth, rounded heads, which cause less tissue irritation, can be used with such drivers; however, the use of a chalk-holder type mechanism does not allow for a tight seating of the head against the bone and also prevents countersinking of the screw head within the bone.

[0007] Prior art screw and driver combinations also exist which possess internal driving mechanisms, such as an internal hex socket for receiving a corresponding driver. However, these screws merely allow for proper seating and countersinking of the screw head or top end of headless screws, but do not provide an internal capture surface for securing the screw to the driver prior to insertion in the bone in a manner that allows the screw to stay positioned on the driver during manipulation, yet be released when desired.

[0008] Some such screws additionally include an axial cannulation through the length of the screw body through which a guide wire is threaded to both guide the screw to the insertion sight and allow retrieval of the screw if lost prior to or during insertion, such as screws with an internal driving surface and a cannulated design. The guide wire method allows for re-capture of a lost screw but does not prevent the initial loss of the screw due to disengagement from the driver during insertion.

[0009] Prior art screw and driver combinations which provide for internal capture of the screw prior to insertion often do not allow sufficiently rigid capture of the screw to the driver to prevent movement of the screw relative to the driver during insertion, and such screws frequently possess other serious structural and functional problems. For instance, prior art screws having one or both of an internal capture surface and internal driving surface are disadvantageous in that the creation of the socket, enlarged bore, or other recession into the head and upper portion of the screw shank reduces the structural soundness and weakens the fatigue strength of the screw, which may result in breaking of the head or upper portion of the shank.

[0010] Accordingly, what is needed is an orthopedic screw with an internal capture surface capable of rigidly engaging a driver prior to and during insertion of the screw in a patient yet releasing from the driver when desired, while simultaneously maintaining structural soundness and adequate fatigue and head break strength. Also needed is a driver designed to correspond to the internal capture and driving mechanism of the screw, and methods of implanting and using the screw. Further, what is needed is a system for use in a procedure for the fixation of an orthopedic implant in a patient that includes an orthopedic implant and screws with

an internal capture surface and adequate strength which are adapted to secure the implant to the skeletal system of a patient.

SUMMARY OF THE INVENTION

[0011] Methods, devices and instrumentation of this invention seek to provide an orthopedic retaining device capable of being rigidly coupled to an insertion tool while maintaining structural and functional integrity of the retaining device and capable of being released from the insertion tool after insertion. Rigid internal capture is possible without compromising the strength of the retaining device and while avoiding irritation to surrounding tissue.

[0012] Methods, devices and instrumentation according to this invention more particularly provide an orthopedic screw, an orthopedic screw and driver assembly, a system employing the orthopedic screw for the fixation of orthopedic implants, and methods of using the screw, assembly, and system that provide adequate capture of an orthopedic screw to avoid loss of the screw during implantation, while also maintaining adequate structural and functional integrity of the screw. These and other aspects of the orthopedic screw, assembly, and system of this invention make them easier and more practical to use than prior art orthopedic screws, assemblies, and systems.

[0013] One orthopedic screw according to this invention includes a head, an internal capture surface, and a shank extending from the screw head to a distal tip. The screw shank has an enlarged diameter at the trailing end, in the area just under the head of the screw, in order to accommodate the internal capture surface without sacrificing the strength or structural soundness of the screw. The screw also includes a continuous thread along at least a portion of the shank extending radially outward from the shank. The enlarged diameter of the trailing end of the shank of a screw according to this invention provides adequate strength and better purchase of the bone material.

[0014] The internal capture surface of the screw allows the screw to be securely attached to a driver prior to insertion of the screw into the bone and released from the driver after insertion, which avoids the loss of the screw in the soft tissue of the patient during the procedure. The enlarged diameter of the trailing end provides structural reinforcement in the area of the shank below the head in order to compensate for strength lost due to the recession of the capture mechanism into the head and upper body of the screw.

[0015] One screw assembly according to this invention includes an orthopedic screw, as described above, in combination with a driver having a driving member adapted to engage the internal capture surface of the screw, and a locking member adapted to engage the internal capture surface of the screw to secure the screw to the driver. An additional aspect of this invention is an system for use in fixing an orthopedic implant in a patient. Such a system includes screws of-this invention and an orthopedic implant, such as an intramedullary nail or fracture reduction rod, an orthopedic plate, external fixture, tibia base, or acetabular shell, which can be secured to the skeletal system of a patient using an orthopedic screw according to this invention.

[0016] Another aspect of this invention also seeks to provide a method of using the orthopedic screw assembly for manipulating a screw in bone material without a significant risk of losing the screw. Another aspect of this invention provides a method of using the orthopedic screw and screw assembly for repairing a bone fracture or for fixing an orthopedic implant in a patient.

[0017] The screws and screw assemblies of the present invention provide many benefits and advantages. One feature according to one aspect of this invention is the ability to safely drill a bone screw with a variety of drivers including power and hand drivers.

[0018] Another feature of another aspect of this invention is a bone screw that will not cause significant irritation to adjacent soft tissue and that is adapted for countersinking into the bone.

[0019] Another feature of an aspect of this invention is a bone screw with an internal capture surface without a corresponding reduction in screw strength or integrity. The screw is structurally sound and is at least equivalent in strength to bone screws without internal capture surfaces which are currently on the market.

[0020] Yet another feature of an aspect of this invention is an orthopedic screw assembly that securely retains a screw to a driver prior to and during insertion of the screw into a bone to avoid loss of the screw in surrounding soft tissue.

[0021] Another feature of an aspect of this invention is the ability to easily release the screw from the driver after insertion into the patient.

[0022] These and other features of this invention will become apparent after a review of the following detailed description of the disclosed embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] **FIG. 1** is a perspective view of a bone screw according to one embodiment of this invention.

[0024] **FIG. 2** is a side view of the screw of **FIG. 1**.

[0025] **FIG. 3** is a top plan view of the screw of **FIG. 1**.

[0026] **FIG. 4** is a partial side view of the screw of **FIG. 1**.

[0027] **FIG. 5** is a perspective view of the head and internal capture surface of a screw according to one embodiment of this invention.

[0028] **FIG. 6** is a perspective view of the head and internal capture surface of the screw of **FIG. 1**.

[0029] **FIG. 7** is a side view of the sleeve portion of a driver according to one embodiment of this invention.

[0030] **FIG. 8** is a side view of a locking member of a driver according to one embodiment of this invention.

[0031] **FIG. 9** is a side view of a driver according to one embodiment of this invention showing the locking member of **FIG. 8** inserted into the sleeve member of **FIG. 7**.

[0032] **FIG. 10** is an exploded perspective view of a screw assembly according to one embodiment of this invention.

[0033] **FIG. 11** is a perspective view of a screw assembly according to one embodiment of this invention.

[0034] **FIG. 12** is a side view in partial cross-section of a screw assembly according to one embodiment of this invention.

[0035] **FIG. 13** is an exploded, cross-sectional view of a portion of a screw assembly according to one embodiment of this invention.

[0036] **FIG. 14** is a side view in partial cross-section of a screw assembly according to one embodiment of this invention being used to implant a screw into a patient to secure an orthopedic implant.

[0037] **FIG. 15** is a perspective anatomical view of a screw according to one embodiment of this invention used to secure an intramedullary nail inserted in a bone of a patient.

DETAILED DESCRIPTION

[0038] Methods, devices and instrumentation according to this invention seek to improve orthopedic surgical procedures involving the use of orthopedic screws, such as placing screws in the fracture reduction of bones to stabilize a bone fracture and in fixing orthopedic implants to the skeletal system of a patient. Methods, devices and instrumentation according to this invention provide an orthopedic screw having an internal capture surface and an enlarged diameter at the trailing end of the shank. Internal capture allows a countersink of the screw, thereby minimizing irritation to surrounding tissue. The enlarged shank diameter at the trailing end provides structural reinforcement to the area of the screw housing the internal capture surface and also allows better purchase of the bone material.

[0039] Methods, devices and instrumentation according to this invention seek to provide a screw assembly including an orthopedic screw and driver with driving and retaining members for simultaneously driving the screw into the bone while securing the screw to the driver to avoid loss of the screw during insertion. The screw, screw assembly, and methods of use improve orthopedic surgery by reducing the risk of losing the screw during the surgical procedure and by providing this advantage without a corresponding loss of screw strength, stability, fit or comfort.

[0040] Consider one example of the instrumentation and devices according to this invention. Generally, an orthopedic screw of this invention includes a head or top end, an internal capture surface, and a shank extending from the screw head to a distal tip. As used herein the term "head" means any head or top end of a screw which houses at least a portion of an internal capture surface. The screw shank has trailing end adjacent to the head of the screw, an intermediate section, and a leading end adjacent to the distal tip. The screw also includes a substantially continuous thread along at least a portion of the shank which extends radically outward from the shank. Preferably, the head of the screw is adapted for countersinking into the bone, and contains an internal capture surface recessed into the head and upper portion of the screw shank, which is adapted to engage and secure the screw to a corresponding driver in a manner that allows the screw to stay securely positioned on the driver during manipulation of the screw, yet be released from the driver when desired. To accommodate this recessed internal capture surface and provide adequate strength and structural reinforcement to the trailing end of the shank, the diameter of the shank is larger at the trailing end of the shank than in an adjacent shank section.

[0041] The screw assembly of this invention includes the orthopedic screw described above and a driver adapted to retain and engage the screw. The assembly may be manipulated by a surgeon to place the screw into a pre-drilled hole in a patient's bone and to drive the screw securely into the bone material. However, if the screw is a self drilling screw, a pre-drilled hold is not necessary. The surgeon may optionally countersink the head of the screw into the bone material to further avoid irritation of the surrounding tissue. Once securely seated in the bone, the surgeon can then release the screw by disengaging the driver from the internal capture surface of the screw.

[0042] The screw of this invention is adapted to be used alone or in conjunction with a system for use in repairing a bone fracture or in fixing an orthopedic implant in a patient. The screw can be used alone to aid in the reduction of small bone fractures. Additionally, a screw according to this invention can be used in conjunction with an orthopedic implant to fix the implant securely to the skeletal system of the patient. Possible orthopedic implants include, but are not limited to intramedullary nails or reduction rods, plates, external fixtures, tibia bases, and acetabular shells.

[0043] **FIGS. 1 through 6** depict one embodiment of a screw according to this invention. As shown in the figures, orthopedic screw **30** includes a head **32** and a body **34**. Preferably, head **32** is adapted to countersink into the bone in order to avoid soft tissue irritation by the head **32** of the screw **30**. Body **34** includes shank portion **36** extending from head **32** to a tip **38** and a continuously advancing spiral ridge or thread **40** threaded evenly about the outer surface of the shank portion **36**. Body **34** optionally also includes a flute **42** for the removal of bone chips as screw **30** is implanted into the bone. Tip **38** of body **34** is a self tapping, non-self drilling tip with a generally conical configuration with a foreshortened end, e.g. a frusto-conical tip.

[0044] Preferably, screw **30** is a self-tapping, non self-drilling bone screw so that tip **38** requires a predrilled hole before insertion into the bone and only thread **40** of screw **30** cuts into the bone. The pitch of the threading **40** at tip **38** should be sufficiently small to advance the screw **30** at a rate which allows tip **38** to advance into the bone, but sufficiently large to provide adequate bone purchase and to minimize the number of turns required to seat the screw. A suitable pitch for threading **40** may be in the range of about 5 threads-per-inch to about 50 threads-per-inch.

[0045] The length of the screw **30** should be adapted to correspond to the use of the screw. The screw can be any suitable length; preferably, the length of the screw **30** is generally from about 20 mm to about 160 mm. More preferably, the length of screw **30** is from about 20 mm to about 110 mm. Preferably, the length of the body is approximately 4 to 6 mm less than the total length of the screw, depending on the head shape and length.

[0046] **FIG. 4** is a side view of the screw of **FIG. 1** and shows the detailed characteristics of the shank **36** and thread **40** of screw body **34**. Screw body **34** has an minor diameter **44**, defined by the diameter of the shank **36**, and an major diameter **46**, defined by the diameter of the thread **40**. The thread height **48** is equal to one half of the difference between the minor diameter **44** and the major diameter **46**. The difference is divided by two to account for the thread height on either side of the shank. Alternatively, major

diameter **46** can be described as the sum of the minor diameter **44** and twice the thread height **48**. Note that minor diameter **44**, major diameter **46**, and thread height **48** vary along the length of the screw body, as described below.

[**0047**] Shank **36** has three sections: trailing end **50**; intermediate section **52**; and leading end **54**. Trailing end **50** is the portion of the shank adjacent to screw head **32**, leading end **54** is the portion of the shank adjacent to the frusto-conical tip **38**, and intermediate section **52** is the portion of the shank between the leading and trailing ends. Each shank section has a minor diameter **44** which may or may not remain constant from one section to another or within a section itself. Thus, trailing end **50** has a first minor diameter **51**, intermediate section **52** has a second minor diameter **53**, and leading end **54** has a third minor diameter **55**.

[**0048**] Intermediate section **52**, of the embodiment shown in FIGS. **1-6**, has a generally cylindrical geometry with a substantially constant minor diameter **53**. The minor diameter can be any suitable length adapted to the size and function of the screw. Preferably, the second minor diameter **53** of the screw of the present invention is generally from about 6.0 mm to about 3.5 mm, more preferably from about 5.5 mm to about 4.0 mm, and most preferably from about 5.0 mm to about 4.5 mm.

[**0049**] Trailing end **50** has a minor diameter **51** which is greater than second minor diameter **53** of the intermediate section. This enlarged minor diameter at the trailing end provides the ability to house at least part of an internal capture mechanism while maintaining sufficient fatigue and head break strength, qualities which are critical in this portion of the shank. This enlarged first minor diameter **51** may be provided by a taper of the trailing end, such that the taper widens from the intermediate section in the direction of the screw head.

[**0050**] In the embodiment shown in FIGS. **1-6**, trailing end **50** includes first taper **56** extending between the intermediate section **52** and the screw head **30** at an angle θ. Although angle θ may be any suitable angle, θ is generally from about 1° to about 8°, and preferably from about 1° to about 3°. The tapered geometry of trailing end **50** is such that first minor diameter **51** increases from the section adjacent to intermediate section **52** in the direction of screw head **30**. In this manner, first taper **56** provides the upper portion of the shank with an enlarged first diameter **51** towards the head of the screw to accommodate the recessed internal capture surface **78**, shown in **FIGS. 5 and 6**, without sacrificing strength or structural integrity. Taper **56** also provides a wedge fit which allows the screw to feel tighter when seated in the bone.

[**0051**] In the embodiment shown, leading end **54** includes a second taper **58** extending from the end of the intermediate section **52** to the tip **38** at an angle ϕ. Angle ϕ may also be any suitable angle, and is generally from about 1° to about 8°, and preferably from about 1° to about 3°. Thus, leading end **54** has a generally tapered geometry such that the third minor diameter **55** decreases from the section adjacent to intermediate section **52** in the direction of tip **38**. Second taper **58** narrows towards the tip of the screw creating a frusto-conical tip area, allowing the screw to follow the pre-drilled hole more effectively and to advance more easily into the bone and through an aperture in an orthopedic implant.

[**0052**] While the embodiment shown in **FIGS. 1 through 4** has a taper at both the leading and trailing ends, any screw with an enlarged first minor diameter, to accommodate a recessed internal capture mechanism, is within the scope of this invention. For instance, a screw according to this invention may have a uniform taper along the shank such that the minor diameter continually decreases in the direction of the tip. Alternatively, a screw according to this invention may have a uniform minor diameter throughout the intermediate section and leading end such that the second and third minor diameters are equivalent.

[**0053**] Additionally, the screw thread, thread height, and major diameter of a screw of this invention may vary along the length of the screw body. As with the minor diameter, each shank section has a corresponding thread section and major diameter defined by the relative thread height.

[**0054**] In the embodiment shown in **FIGS. 4 through 6**, screw thread **40**, like the shank **38**, varies along the length of the screw body **34** and is adapted to the needs and functions of the various regions of the screw. Although the pitch of thread **40** remains substantially constant, thread sections **72**, **60**, and **66** along corresponding shank sections **50**, **52**, and **54**, respectively, are structurally and functionally distinct. Additionally, thread sections **72**, **60**, and **66** also define three corresponding major diameters: fist major diameter **73**, second major diameter **61**, and third major diameter **67**.

[**0055**] Thread **60** in intermediate section **52** has a substantially constant thread height **64**, due to the substantially constant second minor diameter **53** and second major diameter **61** of shank **36** in intermediate section **52**. The major diameter of the thread is suited to the size of the screw and the intended function; preferably, the major diameter is from about 3.5 mm to about 6.0 mm, more preferably from about 4.5 mm to about 5.0 mm. Additionally, the ridge top **62** of intermediate thread section **60** is preferably relatively broad and wide as if the pointed end has been shaved off. This flat ridge top is appropriate for the soft trabecular region of the bone where the intermediate section **52** will reside. The flat ridge top and constant minor diameter of the intermediate section also suit a screw adapted for insertion through an aperture in an orthopedic implant for fixing the implant to the skeletal system of a patient.

[**0056**] Taper **58** on leading end **54** results in a decreasing minor diameter **55**, but the third major diameter **67** is the same as second major diameter **61**. The substantially constant major diameter through intermediate section **52** and leading end **54** results in a thread height **70** of thread **66** along leading end **54** that is greater than the thread height **64** of thread **60** in intermediate section **52**. This increased thread height provides a better "bite" or grasp into the bone and more effectively draws the screw into the bone. The ridge top **68** in this section is narrow, or pointy, for better pull through and purchase, particularly on the far cortex of the bone. The cortex, unlike the trabecula, is hard and provides strength to the bone, and thus requires a stronger grasp.

[**0057**] In trailing end **50** the thread height **76** of thread **66** is also greater than thread height **64** of intermediate thread section **60** because both the first minor diameter **51** and first major diameter **73** increase along taper **56** in the direction of the screw head **32**, providing room for the recessed internal

capture surface, increased strength, and a tight wedge fit of the trailing end of the screw. The ridge top **74** of thread **72** along trailing end **50** is also generally narrow and pointy to provide for better seating of the screw and better purchase in the hard bone material of the near cortex.

[**0058**] The dual tapers **56**, **58** and an increased height of thread **40** on leading end **54** and trailing end **50** of screw **30** provides improved purchase on both the near and far cortex of the bone. Intermediate section **52** does not require a tapered geometry or as high thread height because it occupies the inner portion of the bone with trabecular bone tissue, a softer, spongy bone tissue, and optionally occupies the interior of an aperture in an orthopedic implant when the screw is used for fixing an orthopedic implant in a patient.

[**0059**] As discussed above, the trailing end **50** of shank **36** has an enlarged minor diameter **51** to provide structural reinforcement for the internal capture surface, which is recessed into the head and optionally into at least part of the screw body **34**. In one embodiment of the invention, the internal capture surface includes a recessed geometrically shaped socket adapted to engage a corresponding driver and an axial bore extending from the bottom of the socket into the upper portion of the screw shank. The bore includes connecting structure that corresponds to connecting structure on the driver. The connecting structure may be any suitable structure that couples the screw to the driver, such as threads, or a snap ring.

[**0060**] **FIGS. 5 and 6** show one embodiment of head **32** with internal capture surface **78** of a screw according to this invention. Internal capture surface **78** is recessed into screw head **32** to allow the screw to be adequately seated and optionally countersunk into the bone while still being secured to a driver. Generally, a screw according to this invention will have an internal capture surface which includes both a driving surface and a connecting structure for securing the screw to a corresponding connecting structure on a driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

[**0061**] Internal capture surface **78** includes a female socket **80** that is recessed in screw head **32** and provides a driving surface. In this embodiment the socket **80** has a hexagonal shape with sides **82** and bottom **84**. The socket according to the invention may be any geometric shape capable of bearing a torque load applied by a corresponding geometrically shaped driver. Possible shapes include, but are not limited, to hexagons, squares, other polygons, and ovals or other oblong shapes.

[**0062**] The screw according to the embodiment of the invention depicted in **FIGS. 5 and 6** has a hex socket **80** with an axial bore **86** through the bottom **84** of the hex **80**. In one embodiment, axial bore **86** includes internal threads **88** to engage corresponding external threads on a driver to secure the screw to a driver to avoid screw loss during insertion into a patient and to allow easy release of the screw after insertion. Alternative connecting structures may include a groove in the internal capture surface for accommodating a snap ring on a driver, or a small indentation in a side of the internal capture surface to correspond to a ball plunger device on a driver.

[**0063**] A driver according to one embodiment of this invention is adapted to correspond to the internal capture surface of the screw head. **FIGS. 7 through 9** depict a driver adapted to correspond to the internal capture surface **78** described in **FIGS. 5 and 6**. Driver **90** includes driving member **92** and retaining or locking member **94**.

[**0064**] Driving member **92** includes a sleeve **96** with a first end **98**, a second end **100**, and a cannulation **102** therethrough. First end **98** includes a connector **104** adapted to engage a conventional driving device (e.g. a manual handle or power driver) and second end **100** includes a geometrically-shaped male end **106** adapted to engage the corresponding geometrically-shaped female socket **80** of screw head **32**. In one embodiment, the geometrically shaped male end **106** of second end **100** is an external hex **108** adapted to engage internal hex socket **80** of screw head **32**. External hex **108** has sides **110** corresponding to the sides **82** of hex socket **80**. However, as discussed above, second end **100** may be any structure that corresponds to the shape of the internal socket of the screw head, which can be any shape capable of bearing a torque load. Thus, the geometrically shaped male end **106** may have other shapes such as oval, square, triangle, or other polygon.

[**0065**] Driver **90** also includes a retaining or locking member **94**. In one embodiment, shown in **FIG. 8**, locking member **94** is elongated rod **112**, insertable within cannulation **102** of sleeve **96**. Rod **112** has a first end **114** and a second end **116**. First end **114** may optionally include a tip **118** with a recess or slot **120** adapted to engage a driver such as a flathead or Phillips screwdriver. Second end **116** has structure that corresponds to connecting structure in screw head **32**, so that rod **112** is inserted within the sleeve **96** and engages screw **30**. In this manner, screw **30** is drawn toward and rests adjacent to assembled driver **90**. In one embodiment of the invention, shown in **FIGS. 5 and 6**, axial bore **86** of head **32** has internal threads **88**, and locking member **94** has externally threaded portion **122** with threads **124** on second end **116** adapted to engage the internal threads **88** of axial bore **86** of screw **30**. Thus, in this embodiment, the connecting structure is a threaded bore and corresponding threaded rod, which provides a sufficiently rigid, but easily releasable internal capture surface. Alternative locking members include, but are not limited to snap rings and ball plunger devices. These and other capture mechanisms known to those of skill in the art are included within the scope of this invention.

[**0066**] **FIG. 9** shows locking member **94** inserted within driving member **92** to form assembled driver **90**. **FIGS. 10 through 12** show exploded and assembled views of a screw and driver assembly according to this invention.

[**0067**] One method of using one form of structure according to this invention, which includes an orthopedic screw and driver for securing a rod or nail, is as follows. Driving member **92** of driver **90** is coupled with screw **30** by inserting the hex driver **108** of second end **100** of sleeve **96** into the hex socket **80** of internal capture surface **78** in screw head **32**. With the driving member **92** inserted into the corresponding recessed socket of the screw head **32**, locking member **94** is inserted through cannulation **102** of sleeve **96** of driving member **92** and engages the connecting structure of screw **30**. In the embodiment described in the figures, external threads **124** of locking member **94** engage internal threads **88** of axial bore **86** in the screw **30**, drawing the screw up securely against the external hex **108** of driving member **92** and rigidly securing screw **30** to the driver **90**.

[0068] After screw **30** and driver **90** are securely assembled, screw **30** is inserted into a pre-drilled hole and advanced into the bone. If a screw according this invention is self drilling and self tapping, a pre-drilled hole is not necessary. When screw **30** is firmly seated in the bone, the surgeon may disengage driver **90** from screw **30** by separating locking member **94** from internal capture surface **78** of screw **30**, removing locking member **94** from driving member **92** and removing driving member **92** from socket **80**. In one embodiment, disengaging driver **90** involves unscrewing locking member **94** from internal threads **88** of screw **30**.

[0069] A screw according to this invention may be used alone in the reduction of small bone fractures by placing the screw in the fracture to draw the bone fragments together for better healing. However, in many instances a screw of this invention will be used in a procedure for fixing an orthopedic implant in a patient by securing the implant to the skeletal system of a patient. The orthopedic implant used may be one adapted for use in the repair of bone fractures, such as an intramedullary nail, fracture reduction rod, orthopedic plate, or external fixture. Alternatively, the orthopedic implant may be adapted for replacement of a portion of a patient's skeletal system with a prosthesis; such implants include, but are not limited to acetabular shells and tibia bases.

[0070] One method of using a screw according to this invention in the fixation of an orthopedic implant involves providing an implant, such as an intramedullary nail, and surgically placing the implant in the patient. Once the implant is positioned as desired, the surgeon drills a hole in to the patient's bone, such that the hole is aligned with an aperture in the orthopedic implant, which is adapted to receive an orthopedic screw. The diameter of the pre-drilled hole should be less than that of the major diameter of the screw, such that the threads of the screw cut into the bone material. A screw according to this invention is then attached to a corresponding driver as described above and as shown in **FIGS. 9 through 14**. The surgeon then places the tip of the screw into the pre-drilled hole and applies torque to the driver to manipulate the screw into the bone and through the aperture in the orthopedic implant. Optionally, the leading end of the screw exits the opposite side of the implant aperture and contacts the far cortex of the bone. When the screw is positioned in the bone as desired, the surgeon then detaches the screw from the driver, as described above, leaving the screw securely seated in the bone and orthopedic implant, thereby securing the orthopedic implant to the patient's skeletal system.

[0071] **FIG. 14** depicts a screw **30** and driver **90** according to this invention being used to insert screw **30** into a bone and through an aperture **128** in an intramedullary nail **126** in the bone of a patient. In this figure, a manual driving handle **125** has been attached to the connection configuration **104** on the first end of driving member **92** to allow the surgeon to manually apply torque to the driver **90**, thereby rotating the screw to manipulate it into the bone material. **FIG. 15** shows an anatomical perspective view of a system according to this invention including a screw **30** of this invention used to securely fix and provide rotational stability to an intramedullary nail **126** which has been placed in the intramedullary canal **130** of a patient's bone **132**, shown surrounded by soft tissue **134**. As shown, screw **30** is inserted through the cortical bone material **132** and through aperture **128** in the intramedullary nail **126**, thereby securing and stabilizing nail **126**.

[0072] The foregoing description of the preferred embodiments of the invention has been presented only for the purpose of illustration and description and is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to explain the principles of the invention and their practical application so as to enable others skilled in the art to utilize the invention and various embodiments and with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. An orthopedic screw for use in a surgical procedure comprising:

(a) a head;

(b) a body comprising:

a distal tip;

a shank extending from the head to the tip, the shank having a leading end adjacent the distal tip, a trailing end adjacent the head, and an intermediate section extending between the leading end and the trailing end,

wherein the trailing end has a first diameter and the intermediate section has a second diameter, and

wherein the first diameter is greater than the second diameter at least in part to accommodate an internal capture surface recessed into the head, the capture surface coaxial with the trailing end of the body; and

a substantially continuous thread extending along at least a portion of the body, the thread extending radially outward from the shank; and

(c) an internal capture surface recessed into the head and into at least a portion of the body, wherein the internal capture surface is adapted to receive a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

2. A screw according to claim 1, wherein the distal tip has a generally conical shape.

3. A screw according to claim 1, wherein the screw is self tapping.

4. A screw according to claim 1, wherein the screw is self tapping and self drilling.

5. A screw according to claim 1, wherein the shank has a substantially cylindrical shape throughout the intermediate section.

6. A screw according to claim 1, wherein the shank is tapered at the trailing end, such that the first diameter increases along the trailing end in the direction of the head.

7. A screw according to claim 1, wherein the leading end has a third diameter and wherein the shank is tapered at the leading end, such that the third diameter decreases along the leading end in the direction of the distal tip.

8. A screw according to claim 1, further comprising a major diameter defined by the substantially continuous thread, wherein the trailing end has a first major diameter and the intermediate section has a second major diameter.

9. A screw according to claim 8, wherein the first major diameter is greater than the second major diameter, such that along the leading end of the shank, the thread has a thread height that is at least as high as a thread height of a thread along the intermediate section of the shank.

10. A screw according to claim 8, wherein the leading end has a third major diameter.

11. A screw according to claim 10, wherein the shank is tapered at the leading end, such that the third diameter decreases along the leading end in the direction of the distal tip, and the third major diameter remains substantially constant and is substantially equal to the second major diameter, such that the combination of the decreasing third shank diameter and constant third major diameter result in an increasing thread height of the thread along the leading end in the direction of the distal tip.

12. A screw according to claim 1, wherein the internal capture surface comprises:

a geometrically-shaped female socket adapted to receive a corresponding geometrically-shaped male end of a driver, and

a connecting structure adapted to connect to a corresponding connecting structure on a locking member of a driver.

13. A screw according to claim 12, wherein the geometrically-shaped female socket is in the shape of a polygon.

14. A screw according to claim 13, wherein the polygon is a hexagon.

15. A screw according to claim 13, wherein the polygon is a square.

16. A screw according to claim 12, wherein the geometrically shaped female socket is in the shape of an oval.

17. A screw according to claim 12, wherein the connecting structure comprises an axial bore extending through the bottom of the geometrically-shaped female socket and into at least a portion of the body, the bore further comprising internal threads around the circumference of the bore for engaging corresponding threads on a locking member of a driver.

18. A screw according to claim 12, wherein the connecting structure comprises a generally circular groove adapted to function with a snap ring on a locking member of a driver, such that when the snap ring engages the groove the screw is secured to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

19. A screw according to claim 12, wherein the connecting structure comprises an indentation on an inside surface of the internal capture surface which is adapted to function with a ball plunger mechanism on a locking member of a driver, such that when the ball plunger engages the indentation, the screw is secured to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

20. A orthopedic screw for use in a surgical procedure comprising:

(a) a head;

(b) a body comprising:

a generally conical distal tip;

a shank extending from the head to the tip, the shank having a leading end adjacent the distal tip, a trailing end adjacent the head, and an intermediate section located between the leading end and trailing end,

wherein the trailing end has a first diameter, the intermediate section has a second diameter and the leading end has a third diameter, and

wherein the shank has a substantially cylindrical shape throughout the intermediate section and is tapered at both the leading and trailing ends such that the second diameter remains substantially constant along the intermediate section, the second diameter is greater than the third diameter, which decreases along the leading end in the direction of the conical tip, and the first diameter is greater than the second diameter and increases along the trailing end in the direction of the head, at least in part to accommodate an internal capture surface recessed into the head, the capture surface coaxial with the trailing end of the body; and

a substantially continuous thread extending along at least a portion of the body, the thread extending radially outward from the shank and defining a first, second, and third major diameters, which are generally coaxial to first, second and third diameters of the shank, wherein the first major diameter is greater than the second major diameter, and the third major diameter is substantially equal to the second major diameter; and

(c) an internal capture surface recessed into the head and into at least a portion of the body, wherein the internal capture surface is adapted to receive a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

21. A screw according to claim 20, wherein the internal capture surface comprises:

(a) a geometrically-shaped female socket adapted to receive a corresponding geometrically-shaped male end of a driver, and

(b) a connecting structure adapted to connect to a corresponding connecting structure on a locking member of a driver.

22. A screw according to claim 21, wherein the geometrically-shaped female socket is in the shape of a polygon.

23. A screw according to claim 22, wherein the polygon is a hexagon.

24. A screw according to claim 22, wherein the polygon is a square.

25. A screw according to claim 21, wherein the geometrically shaped female socket is in the shape of an oval.

26. A screw according to claim 21, wherein the internal capture surface connecting structure comprises an axial bore extending through the bottom of the geometrically-shaped female socket and into at least a portion of the body, the bore further comprising internal threads around the circumference of the bore for engaging corresponding threads on a locking member of a driver.

27. A screw according to claim 21, wherein the connecting structure comprises a generally circular groove adapted to function with a snap ring on a locking member of a driver, such that when the snap ring engages the groove the screw is secured to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

28. A screw according to claim 21, wherein the connecting structure comprises an indentation on an inside surface of the internal capture surface which is adapted to function with a ball plunger mechanism on a locking member of a driver, such that when the ball plunger engages the indentation, the screw is secured to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

29. An orthopedic screw for use in a procedure for the fixation of an orthopedic implant in a patient comprising:

(a) a head adapted to countersink into a bone;

(b) a body comprising:

a generally conical distal tip;

a shank extending from the head to the tip, the shank having a leading end adjacent the distal tip, a trailing end adjacent the head, and an intermediate section located between the leading end and trailing end,

wherein the trailing end has a first diameter, the intermediate section has a second diameter and the leading end has a third diameter, and

wherein the shank has a substantially cylindrical shape throughout the intermediate section and is tapered at both the leading and trailing ends such that the second diameter remains substantially constant along the intermediate section, the second diameter is greater than the third diameter, which decreases along the leading end in the direction of the conical tip, and the first diameter is greater than the second diameter and increases along the trailing end in the direction of the head, at least in part to accommodate an internal capture surface recessed into the head, the capture surface coaxial with the trailing end of the body; and

a substantially continuous thread extending along at least a portion of the body, the thread extending radially outward from the shank and defining a first, second, and third major diameters, which are generally coaxial to first, second and third diameters of the shank, wherein the first major diameter is greater than the second major diameter, and the third major diameter is substantially equal to the second major diameter; and

(c) an internal capture surface recessed into the head and into at least a portion of the body, wherein the internal capture surface comprises:

a geometrically-shaped female socket adapted to receive a corresponding geometrically-shaped male end of a driver, and

an axial bore extending through the bottom of the geometrically-shaped socket and into at least a portion of the body, wherein the axial bore further comprises internal threads around the circumference of the bore for engaging corresponding threads on a locking member of a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

30. A system for use in a procedure for the fixation of an orthopedic implant in a patient, comprising:

(a) an orthopedic implant which is adapted to be implanted in a patient and held in place by one or more orthopedic screws, wherein the orthopedic implant comprises one or more apertures adapted to receive an orthopedic screw for securing the implant to the skeletal system of the patient as desired;

(b) an orthopedic screw adapted for insertion into a bone and through an aperture in an orthopedic implant to secure the orthopedic implant to the skeletal system of the patient as desired, wherein the screw comprises:

(i) a head;

(ii) a body comprising:

a distal tip;

a shank extending from the head to the tip, the shank having a leading end adjacent the distal tip, a trailing end adjacent the head, and an intermediate section extending between the leading end and the trailing end,

wherein the trailing end has a first diameter and the intermediate section has a second diameter, and

wherein the first diameter is greater than the second diameter at least in part to accommodate an internal capture surface recessed into the head, the capture surface coaxial with the trailing end of the body; and

a substantially continuous thread extending along at least a portion of the body, the thread extending radially outward from the shank; and

(iii) an internal capture surface recessed into the head and into at least a portion of the body, wherein the internal capture surface is adapted to receive a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

31. A screw according to claim 30, wherein the distal tip has a generally conical shape.

32. A screw according to claim 30, wherein the screw is self tapping.

33. A screw according to claim 30, wherein the screw is self tapping and self drilling.

34. A screw according to claim 30, wherein the shank has a substantially cylindrical shape throughout the intermediate section.

35. A screw according to claim 30, wherein the shank is tapered at the trailing end, such that the first diameter increases along the trailing end in the direction of the head.

36. A screw according to claim 30, wherein the leading end has a third diameter and wherein the shank is tapered at the leading end, such that the third diameter decreases along the leading end in the direction of the distal tip.

37. A screw according to claim 30, wherein the screw further comprises a major diameter defined by the substantially continuous thread, and wherein the trailing end has a first major diameter and the intermediate section has a second major diameter.

38. A screw according to claim 37, wherein the first major diameter is greater than the second major diameter, such that along the leading end of the shank, the thread has a thread height that is larger than a thread height of a thread along the intermediate section of the shank.

39. A screw according to claim 37, wherein the leading end has a third major diameter.

40. A screw according to claim 39, wherein the shank is tapered at the leading end, such that the third diameter decreases along the leading end in the direction of the distal tip, and the third major diameter remains substantially constant and is substantially equal to the second major diameter, such that the combination of the decreasing third shank diameter and constant third major diameter result in an increasing thread height of the thread along the leading end in the direction of the distal tip.

41. A system according to claim 30, further comprising a driver for manipulating the screw into the bone and through an aperture in the orthopedic implant, wherein the driver comprises:

(a) a driving member comprising a first end adapted to engage a conventional driving device and a second end adapted to be received within the internal capture surface of the screw and to engage the screw; and

(b) a locking member adapted to secure the screw to the driving member in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

42. A system according to claim 30, wherein the internal capture surface of the screw comprises:

(a) a geometrically-shaped female socket adapted to receive a corresponding geometrically-shaped male end of a driver, and

(b) a connecting structure adapted to connect to a corresponding connecting structure on a locking member of a driver.

43. A system according to claim 42, wherein the connecting structure comprises an axial bore extending through the bottom of the geometrically-shaped socket and into at least a portion of the body, wherein the axial bore further comprises internal threads around the circumference of the bore for engaging corresponding threads on a locking member of a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

44. A system according to claim 43, further comprising a driver adapted to correspond to the internal capture surface of the screw and for manipulating the screw into the bone and through an aperture in the orthopedic implant comprising:

(a) a sleeve having a first end, a second end, and a cannulation therethrough,

wherein the first end is adapted to engage a conventional driving device, and the second end comprises a geometrically-shaped male end adapted to correspond to the geometrically shaped female socket of the internal capture surface of the screw and to engage the screw; and

(b) an elongated rod having a first end and a second end, wherein the rod is adapted to be inserted within the cannulation of the sleeve, and

wherein the first end is adapted to engage a conventional driving device and the second end comprises external threads adapted to correspond to the internal threads of the axial bore of the screw to secure the screw to the driver, such that when the rod is inserted into the sleeve of the driving member and screwed into the axial bore the internal socket of the screw is drawn securely against the driving member, allowing the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

45. A system for use in a procedure for the fracture reduction of bones, comprising:

(a) an intramedullary nail adapted to be inserted into an intramedullary canal of a long bone to stabilize a fracture of the bone, wherein the intramedullary nail comprises one or more apertures therethrough adapted to receive an orthopedic screw;

(b) an orthopedic screw adapted for insertion into the bone and through an aperture in the intramedullary nail, wherein the screw comprises:

(i) a head;

(ii) a body comprising:

a generally conical distal tip;

a shank extending from the head to the tip, the shank having a leading end adjacent the distal tip, a trailing end adjacent the head, and an intermediate section located between the leading end and trailing end,

wherein the trailing end has a first diameter, the intermediate section has a second diameter and the leading end has a third diameter, and

wherein the shank has a substantially cylindrical shape throughout the intermediate section and is tapered at both the leading and trailing ends such that the second diameter remains substantially constant along the intermediate section, the second diameter is greater than the third diameter, which decreases along the leading end in the direction of the conical tip, and the first diameter is greater than the second diameter and increases along the trailing end in the direction of the head, at least in part to accommodate an internal capture surface recessed into the head, the capture surface coaxial with the trailing end of the body; and

a substantially continuous thread extending along at least a portion of the body, the thread extending radially outward from the shank and defining a first, second, and third major diameters, which are generally coaxial to first, second and third diameters of the shank, and wherein the first major diameter is greater than the second major diam-

eter, and the third major diameter is substantially equal to the second major diameter; and

(iii) an internal capture surface recessed into the head and into at least a portion of the body, wherein the internal capture surface is adapted to receive a driver, secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

46. A system according to claim 45, further comprising a driver for manipulating the screw into the bone and through an aperture in the intramedullary nail, wherein the driver comprises:

(a) a driving member comprising a first end adapted to engage a conventional driving device and a second end adapted to be received within the internal capture surface of the screw and to engage the screw; and

(b) a locking member adapted to secure the screw to the driving member in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

47. A system according to claim 45, wherein the internal capture surface of the screw comprises:

(a) a geometrically-shaped female socket adapted to receive a corresponding geometrically-shaped male end of a driver, and

(b) a connecting structure adapted to connect to a corresponding connecting structure on a locking member of a driver.

48. A system according to claim 47, wherein the connecting structure comprises an axial bore extending through the bottom of the geometrically-shaped socket and into at least a portion of the body, wherein the axial bore further comprises internal threads around the circumference of the bore for engaging corresponding threads on a locking member of a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

49. The system according to claim 48, further comprising a driver for manipulating the screw into the bone and through an aperture in the intramedullary nail, wherein the driver comprises:

(a) a sleeve having a first end, a second end, and a cannulation therethrough,

wherein the first end is adapted to engage a conventional driving device, and the second end comprises a geometrically-shaped male end adapted to correspond to the geometrically shaped female socket of the internal capture surface of the screw and to engage the screw; and

(b) an elongated rod having a first end and a second end, wherein the rod is adapted to be inserted within the cannulation of the sleeve, and

wherein the first end is adapted to engage a conventional driving device and the second end comprises external threads adapted to correspond to the internal threads of the axial bore of the screw to secure the screw to the driver, such that when the rod is inserted into the sleeve of the driving member and screwed into the axial bore the internal socket of the screw is drawn securely against the driving member, allowing the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

50. A method of fixing an orthopedic implant in a patient comprising:

(a) providing an orthopedic implant which is adapted to be implanted in a patient and held in place by one or more orthopedic screws, wherein the orthopedic implant comprises one or more apertures adapted to receive an orthopedic screw for securing the implant to the skeletal system of the patient as desired;

(b) providing an orthopedic screw an orthopedic screw adapted for insertion into a bone and through an aperture in an orthopedic implant to secure the orthopedic implant to the skeletal system of the patient as desired, wherein the screw comprises:

(i) a head;

(ii) a body comprising:

a distal tip;

a shank extending from the head to the tip, the shank having a leading end adjacent the distal tip, a trailing end adjacent the head, and an intermediate section extending between the leading end and the trailing end,

wherein the trailing end has a first diameter and the intermediate section has a second diameter, and

wherein the first diameter is greater than the second diameter at least in part to accommodate an internal capture surface recessed into the head, the capture surface coaxial with the trailing end of the body; and

a substantially continuous thread extending along at least a portion of the body, the thread extending radially outward from the shank; and

(iii) an internal capture surface recessed into the head and into at least a portion of the body, wherein the internal capture surface is adapted to receive a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired.

(c) providing a driver comprising

(i) a driving member comprising a first end adapted to engage a conventional driving device and a second end adapted to be received within the internal capture surface of the screw and to engage the screw; and

(ii) a locking member adapted to secure the screw to the driving member in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired

(d) implanting the orthopedic implant in a patient;

(e) drilling a hole in the bone which is aligned with an aperture of the orthopedic implant;

(f) inserting the second end of the driving member into the internal capture surface in the head of the screw;

(g) inserting the locking member into the internal capture surface in the head of the screw;

(h) coupling the locking member and screw by in a manner that draws the screw securely against the driving member, such that a rigid connection is maintained between the screw and driver during manipulation of the screw, yet allows release of the screw when desired;

(i) attaching a conventional driving device to the second end of the driver;

(j) inserting the tip of the screw into the pre-drilled hole in the bone;

(k) applying torque to the driving device to manipulate the screw into the bone and through the aperture in the orthopedic implant;

(l) securely seating the screw in the bone;

(m) disengaging the connecting configuration of the locking member and screw;

(n) removing the locking member from the internal capture surface of the screw; and

(o) removing the driving member from the internal capture surface to release the screw.

51. A method of repairing a bone fracture comprising:

(a) providing an intrameduallary nail adapted to be inserted into an intramedullary canal of a long bone to stabilize a fracture of the bone,

wherein the intramedullary nail comprises one or more apertures therethrough adapted to receive an orthopedic screw;

(b) providing an orthopedic screw adapted for insertion into the bone and through an aperture in the intramedullary nail, wherein the screw comprises:

(i) a head;

(ii) a body comprising:

a generally conical distal tip;

a shank extending from the head to the tip, the shank having a leading end adjacent the distal tip, a trailing end adjacent the head, and an intermediate section located between the leading end and trailing end,

wherein the trailing end has a first diameter, the intermediate section has a second diameter and the leading end has a third diameter, and

wherein the shank has a substantially cylindrical shape throughout the intermediate section and is tapered at both the leading and trailing ends such that the second diameter remains substantially constant along the intermediate section, the second diameter is greater than the third diameter, which decreases along the leading end in the direction of the conical tip, and the first diameter is greater than the second diameter and increases along the trailing end in the direction of the head, at least in part to accommodate an internal capture surface recessed into the head, the capture surface coaxial with the trailing end of the body; and

a substantially continuous thread extending along at least a portion of the body, the thread extending radially outward from the shank and defining a first, second, and third major diametes, which are generally coaxial to first, second and third diameters of the shank, and wherein the first major diameter is greater than the second major diameter, and the third major diameter is substantially equal to the second major diameter; and

(iii) an internal capture surface recessed into the head and into at least a portion of the body, wherein the internal capture surface of the screw comprises:

a geometrically-shaped female socket adapted to receive a corresponding geometrically-shaped male end of a driver, and

an axial bore extending through the bottom of the geometrically-shaped socket and into at least a portion of the body, wherein the axial bore further comprises internal threads around the circumference of the bore for engaging corresponding threads on a locking member of a driver in order to secure the screw to the driver in a manner that allows the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired;

(c) providing a driver for manipulating the screw into the bone and through an aperture in the intramedullary nail, wherein the driver comprises:

(i) a sleeve having a first end, a second end, and a cannulation therethrough,

wherein the first end is adapted to engage a conventional driving device, and the second end comprises a geometrically-shaped male end adapted to correspond to the geometrically shaped female socket of the internal capture surface of the screw and to engage the screw; and

(ii) an elongated rod having a first end and a second end, wherein the rod is adapted to be inserted within the cannulation of the sleeve, and

wherein the first end is adapted to engage a conventional driving device and the second end comprises external threads adapted to correspond to the internal threads of the axial bore of the screw to secure the screw to the driver, such that when the rod is inserted into the sleeve of the driving member and screwed into the axial bore the internal socket of the screw is drawn securely against the driving member, allowing the screw to stay positioned on the driver during manipulation of the screw, yet be released when desired;

(d) implanting the intramedullary nail in the intramedullary canal of the long bone of a patient;

(e) drilling a hole in the bone which is aligned with an aperture of the orthopedic implant;

(f) inserting the geometrically-shaped male end of the driving member into the corresponding geometrically-shaped female socket of the internal capture surface in the head of the screw;

(g) inserting the locking member into the cannulation of the sleeve of driving member such that the second end of the elongated rod is inserted into the axial bore of the screw;

(h) rotating the locking member such that external threads on the second end of the locking member engage the corresponding internal threads of the axial bore of the screw, drawing the screw securely against the driving member, such that a rigid connection is maintained between the screw and driver;

(i) attaching a conventional driving device to the second end of the driver;

(j) inserting the tip of the screw into the pre-drilled hole in the bone;

(k) applying torque to the driving device to manipulate the screw into the bone;

(l) securely seating the screw in the bone;

(m) unscrewing the locking member to disengage the threaded end of the locking member from the corresponding threads of the axial bore of the screw;

(n) removing the locking member from the sleeve of the driving member; and

(o) removing the driving member from the internal socket of the head to release the screw.

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