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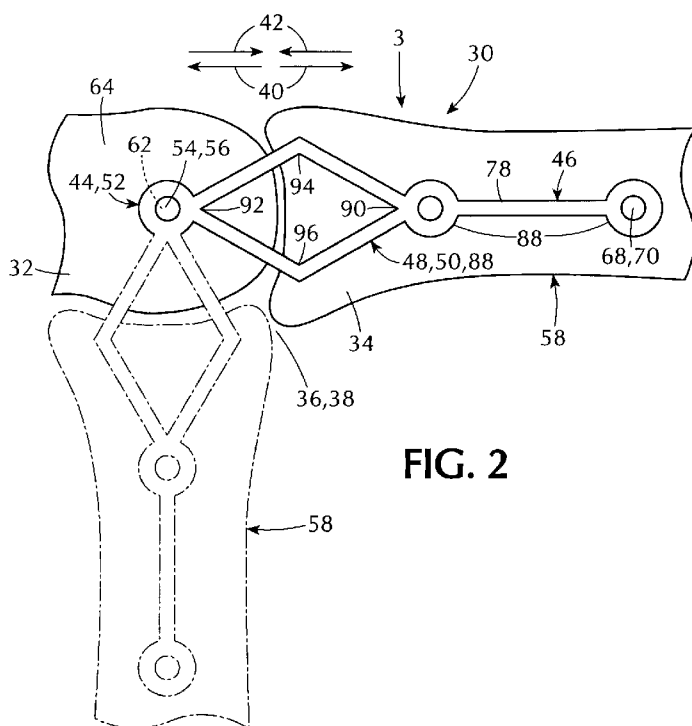


FIG. 2

(57) **Abstract:** An apparatus for bridging between first and second bone units of an injured bone for distraction, compression, static positioning, and/or control of range of motion of at least one of the bones, and a method of implanting and using the apparatus. The apparatus includes first and second attaching apparatus, and control apparatus. The first and second attaching apparatus connects the apparatus to the first and second bone units respectively. The control apparatus is associated with the first and second attaching apparatus to produce at least two conditions: distraction, compression, static position, and control of range of motion of the at least one of the bones. The control apparatus includes a reformably deformable member that moves the first attaching apparatus and the second attaching apparatus relative to each other.



WO 2011/019367 A1

In re APPLICATION OF
VIRAK TAN

FOR A
ORTHOPEDIC EXTERNAL FIXATOR AND METHOD OF USE

1 **ORTHOPEDIC EXTERNAL FIXATOR AND METHOD OF USE**

2 **1. Background of the invention.**

3 **A. Field of the invention.**

4 The embodiments of the present invention relate primarily to orthopedic apparatuses,
5 sometimes referred to as “fixators”, which organize and/or control positioning at joints or
6 fractures, and/or ranges of motion of juxtaposed bone units at joints. These apparatuses
7 according to the embodiments of the present invention can be organized to impose or to
8 relieve physical stresses associated with the bone units and/or with related ligaments
9 and/or tendons. These apparatuses can be organized to all controlled rotation of the bones
10 at the joint. In one embodiment of the present invention, when squeezed, the apparatus
11 generally produces distraction, when relaxed the apparatus general produces contraction.

12 For clarity the embodiments of the present invention are set forth in context of a
13 finger joint. It will, however, be apparent to orthopedic physicians and surgeons and to
14 others that the embodiments of the present invention have comprehensive scope for
15 application to many, many other joints and/or fractures, dislocations, tendon and/or
16 ligament injuries and/or the like.

17 **B. Description of the prior art.**

18 ¹Joint injuries often result in displacement of components of the joint and of bone
19 fragments that have become fractured and dislocated in the injury.

¹ See, Fractures of the Proximal Interphalangeal Joints of the Fingers, C. Y. Ng, C. W. Oliver, Royal Infirmary of Edinburgh, Edinburgh, Scotland, J Bone Surgery [Br] 2009;91-B:705-12, © 2009 British Editorial Society of Bone and Joint Surgery doi:10.1302/0301-620X.91B6. See, Treatment of Proximal Interphalangeal Dorsal Fracture-Dislocation Injuries with Dynamic External Fixation: a Pins and Rubber Band System, S. J. Ellis, R. Cheng, P. Prokopis, A. Chetboun, S. W. Wolfe, E. A. Athanasian, A. J. Weiland, Journal of Hand Surgery, © 2007 American Society for Surgery of the Hand 0363-5023/07/32A08-0018\$32.00/0, doi: 10.1016/j.jhsa.2007.07.001. Both references above are incorporated herein by reference thereto.

1 In the treatment of these injuries it is often required to create traction across a joint
2 so that the components thereof are retained in appropriate relative dispositions during the
3 healing process. It is also advantageous in certain cases to permit gentle controlled
4 movement or relative rotation of the joint, which helps to mold the irregular surfaces and
5 prevents eventual stiffness.

6 Numerous innovations for fixators have been provided in the prior art, which will
7 here be described in chronological order to show advancement in the art, and which are
8 incorporated herein by reference thereto. Even though these innovations may be suitable
9 for the individual purposes to which they address, nevertheless, they differ from the
10 present invention.

11 **(1) *United States Patent Number 5,074,865 to Fahmy.***

12 Referring now to the figures, in which like numerals indicate like parts, and particularly to
13 **FIGURE 1**, which is a diagrammatic side elevational view of the prior art distraction
14 apparatus taught by United States Patent Number 5,074,865 to Fahmy, United States
15 Patent Number 5,074,865 issued to Fahmy on December 24, 1991 in U.S. class 606 and
16 subclass 54 teaches a distraction apparatus **10** for maintaining a fractured joint **12** during
17 healing, including a pair of pins **14** for insertion into bone **16** at positions proximal **18** to
18 and distal **20** to the fractured joint **12**, and a pair of stainless steel wire springs **22** that are
19 adjustably attached to the pair of pins **14** to determine and resiliently maintain the relative
20 spacing of pin insertions **24** into the bone **16** thus to retain the components of the fractured
21 joint **12** during the healing process.

22 To provide initial distraction, unfortunately, Fahmy requires that the bones must
23 first be manually separated before being held by the apparatus. “The insertion of the pins
24 will take place under general or regional anaesthesia, and then while traction is applied to
25 the finger the thicker of the two springs is attached to and between the pins, its position

1 therealong being determined by location in the first or second grooves close to the
2 finger.”[Emphasis added].²

3 To alter the degree of distraction, unfortunately, Fahmy requires that the springs
4 must be manually moved. “The degree of distraction can be initially fixed and
5 subsequently altered easily by moving the two springs closer or spacing them further along
6 the wires, or by adjusting the number of turns of one or both springs between the
7 pins.”[Emphasis added].³

8 Further, the springs of Fahmy are secured to the pins by a polymer/monomer. “The
9 springs may be secured by adding a small amount of mixed past setting polymer and
10 monomer where the springs are attached to the pins * * *.”[Emphasis added].⁴

11 (2) ***International Patent Application Publication Number WO/1992/15258 to Bagits***
12 ***et al.***

13 International Patent Application Publication Number WO/1992/15258 published to Bagits
14 *et al.* on September 17, 1992 in international patent classification A61B 17/60 teaches a
15 disposable external fixator with apparatus for receiving pins known *per se* bored into the
16 fractured bones for fixing them. The fixing apparatus includes a fixing rod with
17 equidistantly spaced and aligned bores near its end parts, and provided with threaded parts
18 at its ends. The diameters of the bores are larger than those of the pins received in them.
19 The fixator further includes two stretching tubes slidably mounted onto the end parts of the
20 fixing rod, and provided with bores of similar diameter, spacing, and position to those of
21 the bores of the fixing rod. Finally, an internally threaded closing piece is shaped to

² Fahmy at col. 2, lines 20-25.

³ Fahmy at col. 2, lines 30-34.

⁴ Fahmy at col. 2, lines 38-40.

1 facilitate the drawing and is screwed on the threaded parts formed at both ends of the
2 fixing rod.

3 **(3) *United States Patent Number 5,207,676 to Canadell et al.***

4 United States Patent Number 5,207,676 issued to Canadell *et al.* on May 4, 1993 in U.S.
5 class 606 and subclass 54 teaches an external fixator for the correction and reduction of
6 bone fragments, which includes a bar fastened to a biocompression system, on which bar
7 and system are disposed the supports for fastening the pins inserted into the bones, the
8 components of which supports are movable. A member permits the longitudinal
9 displacement of a clip, while the biocompression system makes a reciprocating movement.
10 A damping member cooperates with apparatus for regulating the force applied, which are
11 disposed outside the bar. Graduated markings indicate the value of the force applied.

12 **(4) *United States Patent Number 5,376,091 to Hotchkiss et al.***

13 United States Patent Number 5,376,091 issued to Hotchkiss *et al.* on December 27, 1994 in
14 U.S. class 606 and subclass 55 teaches a dynamic joint support having proximal and distal
15 support sections, and apparatus for rigidly connecting each support section to bone, and a
16 pair of hinges connecting each support section to each other and pivoting at the joint to
17 cause movement of the support section and its corresponding attached bone through the
18 movements of flexion and extension. The hinge may be driven in its movement by a gear
19 mechanism that may be disengaged by way of a clutch. The dynamic joint support may
20 also include a distraction mechanism for movement of the bones out of contact in the joint,
21 while allowing for an active range of motion at the joint.

1 **(5) *International Patent Application Publication Number WO/1996/35385 to Bailey***
2 ***et al.***

3 International Patent Application Publication Number WO/1996/35385 published to Bailey
4 *et al.* on November 14, 1996 in international patent classification A61B 17/56 teaches an
5 external fixator for securing a first bone portion in a fixed relationship with respect to a
6 second bone portion. The fixator includes a bone screw clamp for receiving a first bone
7 screw that is connected to the first bone portion and which includes a spherical portion.
8 The fixator further includes a bone screw clamp that is operable to receive a second bone
9 screw that is connected to the second bone portion and which has a spherical portion. The
10 fixator also includes a connection member having a radiographic window to permit
11 radiographic examination of the bone fracture, as well as a cantilever member operable to
12 secure the spherical portions of the first and second bone screw clamps to the connection
13 member.

14 **(6) *International Patent Application Publication Number WO/1999/002097 to***
15 ***Helland.***

16 International Patent Application Publication Number WO/1999/002097 published to
17 Helland on January 21, 1999 in international patent classification A61B 17/66 teaches a
18 distraction apparatus for holding a fracture during the healing process. The apparatus
19 includes screws or pins for insertion into a bone at points proximal and distal relative to a
20 fracture site, and a pair of springs that can be connected externally between the screws or
21 pins at spaced positions thereon. The springs act as an extension spring and a compression
22 spring, respectively, between the screws or pins. The springs are connected at the spaced
23 positions at distances relative to the bone that the springs will exert moments of force in
24 order to obtain a desired torque load at the fracture site.

1 **(7) *International Patent Application Publication Number WO/1999/004714 to***
2 ***Nestorov.***

3 International Patent Application Publication Number WO/1999/004714 published to
4 Nestorov on February 4, 1992 in international patent classification A61B 17/60 teaches an
5 external fixator including threaded carriers with a through hole for receiving bone implants
6 clamped by fixing nuts. The carriers are interconnected by compression-distraction
7 mechanisms and/or ball and socket joints.

8 **(8) *United States Patent Number 5,941,877 to Viegas et al.***

9 United States Patent Number 5,941,877 issued to Viegas *et al.* on August 24, 1999 in U.S.
10 class 606 and subclass 55 teaches a hand fracture, burn, and contraction treatment device
11 that is capable of imparting a desired amount of long term force and moment to the
12 interphalangeal and metacarpalphalangeal joints so as to effectively combat deformity due
13 to burn scar or trauma, to prevent and/or correct contractures, and to reduce and
14 immobilize fractures. The device includes two axial members slidably mounted within
15 respective housings and joined by a spherical joint, with a slot to provide a selectable axis
16 of increased range of motion. The device permits movement of one axial member with
17 respect to the other axial member in up to five degrees of freedom. The device further
18 provides for the adjustable mobilization of each axial member.

19 **(9) *United States Patent Number 5,944,719 to Leban.***

20 United States Patent Number 5,944,719 issued to Leban on August 31, 1999 in U.S. class
21 606 and subclass 59 teaches an external fixator for setting fractured bones, which includes
22 a flexible, articulable column including a series of ball and socket members linked by a
23 tensioning cable threaded therethrough. Tightening the cable forces the ball and socket
24 members together and makes the column rigid. There is a mechanism for tightening the
25 cable and keeping the cable in a tightened position to allow the bones to set without

1 moving. A plurality of pivotable pin holders are arranged along the column for attaching
2 to pins inserted into the fractured bones, thus attaching the column to the bones to be set.
3 There is also a mechanism for fixing each pin holder into a rigid position so that there can
4 be no pivoting motion after the proper position of the fixator has been achieved.

5 **(10) United States Patent Number 5,976,125 to Graham.**

6 United States Patent Number 5,976,125 issued to Graham on November 2, 1999 in U.S.
7 class 606 and subclass 32 teaches an external fixation apparatus for reduction and
8 distraction of a joint injury, such as fracture or dislocation of the proximal and distal bones
9 of a joint from a location external to the soft tissue of a patient. The device includes a
10 proximal fixator, a distal fixator, a proximal wire inserted through the proximal fixator and
11 into a proximal bone, a distal wire inserted through the distal fixator and into a distal bone,
12 and an adjustable distraction mechanism connecting the proximal and distal fixators.

13 **(11) United States Patent Number 6,080,153 to Mata et al.**

14 United States Patent Number 6,080,153 issued to Mata *et al.* on June 27, 2000 in U.S. class
15 606 and subclass 54 teaches an articulation element for the relative positioning of fixation
16 bars or bone pins of an external fixator, which includes a plurality of pairs of jaws. The
17 jaws have on their adjacent faces grooves that form a passage intended to receive a bar or a
18 pin. A spring is interposed between the pairs of jaws. The grooves that form the passage
19 are positioned and arranged so as to have an external opening allowing the bar or bone pin
20 to be snapped in by pressure on it, from the opening of the jaw into the passage, and
21 against the spring force that presses the adjacent faces of the jaws against one another.
22 This force holds the articulation element on the bars or pins before locking of the
23 articulation by way of a clamping shaft.

1 **(12) United States Patent Number 6,162,223 to Orsak et al.**

2 United States Patent Number 6,162,223 issued to Orsak *et al.* on December 19, 2000 in
3 U.S. class 606 and subclass 59 teaches a joint fixator apparatus that conforms to the natural
4 axis of rotation of the joint in question, such as a patient's wrist or knee, to avoid the
5 possibility of bone fragment displacement and/or fracture reduction. The apparatus
6 includes two fixation rod sections or shaft sections with a spring module therebetween.
7 The spring module is in the form of a flexible coupler that connects to respective ends of
8 the external fixator rod. The module can include a removable clip to restrain the motion of
9 the spring a desired amount, such as before healing takes place. The rods can be used to
10 hold pin clamps that then hold bone pins for attachment to selected bones of the patient,
11 such as above and below a joint or above and below a fracture. The pin clamps can be
12 moved along the rod sections to provide distraction of the joints for a ligamentotaxis effect
13 in reducing the fracture.

14 **(13) United States Patent Number 6,162,224 to Huebner.**

15 United States Patent Number 6,162,224 issued to Huebner on December 19, 2000 in U.S.
16 class 606 and subclass 59 teaches a bone fixator for repairing fractures of the distal radius
17 and wrist. It includes, in the preferred embodiment, at least two generally parallel, spaced-
18 apart elongate distal mounting pins with lower ends for mounting in the metacarpal bone
19 and at least two generally parallel, spaced-apart elongate radial mounting pins with lower
20 ends for mounting in the radius. A distal pin clamp assembly secures the distal pins to an
21 elongate distal member. The clamp assembly and pins are movably coupled to the distal
22 member for translational movement along its elongate axis and pivotal motion about a
23 pivot axis generally perpendicular to the elongate axis of the distal member and the
24 elongate axes of the distal pins. A pin mounting carriage holds the radial pins, and an
25 elongate medial assembly is connected at one end to the pin mounting carriage for

1 independent translational motion along an axis generally perpendicular to the elongate
2 axes of the proximal mounting pins and the elongate axis of the medial assembly and
3 coupled at the opposed end through a ball joint to the distal member.

4 **(14) *United States Patent Number 6,171,309 to Huebner.***

5 United States Patent Number 6,171,309 issued to Huebner on January 9, 2001 in U.S. class
6 606 and subclass 57 teaches a bone fixator for repairing fractures of the distal radius and
7 wrist. It includes, in the preferred embodiment, at least two generally parallel spaced-apart
8 elongate distal mounting pins with lower ends for mounting in the metacarpal bone and at
9 least two generally parallel spaced-apart elongate radial mounting pins with lower ends for
10 mounting in the radius. A distal pin clamp assembly secures the distal pins to an elongate
11 distal member. The clamp assembly and pins are movably coupled to the distal member
12 for translational movement along its elongate axis and pivotal motion about a pivot axis
13 generally perpendicular to the elongate axis of the distal member and the elongate axes of
14 the distal pins. The fixator further includes a proximal pin mounting block for securing the
15 radial pins and an elongate medial assembly of adjustable length. The medial assembly is
16 pivotally connected at one end to the pin mounting block for independent pivotal motion
17 about an axis generally parallel to the elongate axes of the proximal mounting pins and
18 coupled at the opposed end through a ball joint to the distal member.

19 **(15) *United States Patent Number US 6,203,548 B1 to Helland.***

20 United States Patent Number US 6,203,548 B1 issued to Helland on March 20, 2001 in
21 U.S. class 606 and subclass 105 teaches a distraction apparatus for holding a fracture
22 during the healing process. The apparatus includes screws or pins for insertion into a bone
23 at points proximal and distal relative to a fracture site, and a pair of springs that can be
24 connected externally between the screws or pins at spaced positions thereon. The springs

1 act as an extension spring and a compression spring, respectively, between the screws or
2 pins. The springs are connected at the spaced positions at distances relative to the bone
3 that the springs will exert moments of force in order to obtain a desired torque load at the
4 fracture site.

5 **(16) United States Patent Number US 6,235,029 B1 to Faccioli et al.**

6 United States Patent Number US 6,235,029 B1 issued to Faccioli *et al.* on May 22, 2001 in
7 U.S. class 606 and subclass 54 teaches an orthopaedic device for the gradual correction of
8 angular and longitudinal defects of elongated bones, which includes at least one first clamp
9 for a first group of screws insertable in a proximal portion of a bone, at least one second
10 clamp for a second group of screws insertable in a distal portion of the bone, and a
11 longitudinal guide bar positioned externally of the limb to be corrected for slidably
12 supporting the clamps. At least one of the clamps is selectively orientable about a
13 substantially transverse axis for carrying out angular corrections of the bone. A
14 compression/distraction device is movably coupleable with the clamps for carrying out
15 longitudinal corrections of the bone. The orientably clamp is adjustable angularly in a
16 predetermined geometric plane, as well as adjustable transversely for the group of bone
17 screws carried by the clamp parallel to themselves for compensating for the lateral
18 movement induced by the angular correction.

19 **(17) United States Patent Application Publication Number US 2001/0049525 A1 to**
20 **Slocum.**

21 United States Patent Application Publication Number US 2001/0049525 A1 published to
22 Slocum on December 6, 2001 in U.S. class 606 and subclass 54 teaches a joint support
23 attachable to a limb of an animal to limit movement of an associated limb joint
24 substantially about a single axis. The joint support includes a radial element having a
25 longitudinal axis and a transverse element having a longitudinal axis. The transverse

1 element is pivotally connected to the radial element about an axis of rotation. The
2 longitudinal axis of the radial element substantially intersects with the axis of rotation, and
3 radial rotation of the radial element is restricted about the axis of rotation. The
4 longitudinal axis of the transverse element is partially fixed relative to the radial element
5 so that it is substantially coplanar with the longitudinal axis of the radial element and
6 substantially offset from the axis of rotation.

7 **(18) *United States Patent Application Publication Number US 2001/0051806 A1 to***
8 ***Ballier.***

9 United States Patent Application Publication Number US 2001/0051806 A1 published to
10 Ballier on December 13, 2001 in U.S. class 606 and subclass 54 teaches a fixation device
11 with clamping jaws and with rods connecting the clamping jaws. The rods are adjustable
12 axially and angularly for positioning relative to the clamping jaws and clampable in the
13 desired position, and with fixation and retaining pins that are receivable in a clampable
14 fashion in the clamping jaws. A fixation pin applicator can be connected in a releasable
15 fashion to the clamping jaws. A fixation pin can be brought into a desired position by way
16 of the fixation pin applicator.

17 **(19) *United States Patent Application Publication Number US 2002/0004659 A1 to***
18 ***Boudard et al.***

19 United States Patent Application Publication Number US 2002/0004659 A1 published to
20 Boudard *et al.* on January 10, 2002 in U.S. class 606 and subclass 54 teaches a fixator
21 including a rigid bar, two pin-holder assemblies that can be moved relative to this bar, and
22 apparatus with which it is possible to immobilize each pin-holder assembly in a defined
23 position relative to the bar. The bar has a cylindrical main part and a spherical part at one
24 end. A first pin-holder assembly includes a one-piece body with a bore passing through it
25 to permit its engagement by sliding on the cylindrical part of the bar. The second pin-

1 holder assembly includes a one-piece body in which a recess is formed. This recess has a
2 zone of partially spherical shape with a radius slightly greater than that of said spherical
3 part. This zone can receive this spherical part with pivoting, without lateral play, and with
4 a possibility of articulation of the second pin-holder assembly.

5 **(20) United States Patent Number US 6,340,361 B1 to Kraus et al.**

6 United States Patent Number US 6,340,361 B1 issued to Kraus *et al.* on January 22, 2002
7 in U.S. class 606 and subclass 59 teaches an external fixator system that includes a clamp
8 adapted to couple a fixator pin to a connecting rod. The clamp includes a slot for
9 transversely receiving the connecting rod. A bolt is inserted through a bore passing
10 transversely to the slot to engage a pin connector holding a fixator pin. The pin connector
11 has a rod-engaging surface that wedges the connecting rod into the slot, thus increasing the
12 clamp's rigidity by preventing rotation of the clamp around the rod and rotation of the pin
13 connector in the clamp body. An aiming device attaches to at least two connecting rods to
14 guide the insertion of fixator pins between the rods. The aiming device is adjustable to
15 accommodate various distances between the rods and has different modes of attachment to
16 the rods to enable the clamp installation either above or below the rods.

17 **(21) United States Patent Application Publication Number US 2002/0013584 A1 to**
18 **Termaten.**

19 United States Patent Application Publication Number US 2002/0013584 A1 published to
20 Termaten on January 31, 2002 in U.S. class 606 and subclass 54 teaches a fixing device for
21 orthopedic applications. At least one coupling member is mounted in the connecting rod
22 of, or the guiding rod for, the clamping members, and intended for receiving orthopedic
23 pins. The coupling member can be brought into a rigid or a flexible coupling position.
24 Further, preferably, it has been provided for that in the flexible coupling position, the
25 flexibility can be adjusted across a certain range.

1 **(22) United States Patent Number US 6,358,255 B1 to Testa.**

2 United States Patent Number US 6,358,255 B1 issued to Testa on March 19, 2002 in U.S.
3 class 606 and subclass 105 teaches a device especially for osteodistractor, configured for
4 attachment to different bone parts that have been separated, and that are bound together by
5 the device that holds the bones parts in a pre-set position and/or simultaneously exerts
6 pressure for distancing or bringing together the bone parts. The device includes at least
7 two elements configured for fastening to two bone parts that are separate from each other.
8 The two elements are coupled together and movable along at least one pre-set direction,
9 there being inserted between them an elastic element for providing a thrust in the
10 distancing or traction direction. The device may be removably coupled to the bone parts to
11 facilitate installation.

12 **(23) United States Patent Application Publication Number US 2002/0115998 A1 to**
13 **Schoenefeld.**

14 United States Patent Application Publication Number US 2002/0115998 A1 published to
15 Schoenefeld on August 22, 2002 in U.S. class 606 and subclass 59 teaches an external
16 fixator for securing a first bone portion in a fixed relationship with respect to a second
17 bone portion, which includes a longitudinally extending rod and a bone screw clamping
18 assembly. The bone screw clamping assembly receives at least one bone screw. The bone
19 screw clamping assembly is mounted to the rod for relative universal movement about a
20 point through which the rod passes, and is normally permitted to longitudinally translate
21 along an axis defined by the rod.

22 **(24) United States Patent Application Publication Number US 2003/0009167 A1 to**
23 **Wozencroft.**

24 United States Patent Application Publication Number US 2003/0009167 A1 published to
25 Wozencroft on January 9, 2003 in U.S. class 606 and subclass 55 teaches a device that

1 immobilizes bones of a patient, such as a surgically exposed femur and tibia, during a knee
2 replacement operation. The device has a vertical frame including a pair of first members
3 and at least one second member bracing the first members. A support mechanism is
4 mounted on the first members to permit adjustment of the height of the support
5 mechanism. A first and second series of cantilever members are supported by the support
6 mechanism. First and second bone engagement mechanisms are mounted on respective
7 cantilever members and engage a patient's surgically exposed first and second bones.

8 **(25) *United States Patent Application Publication Number US 2003/0191466 A1 to***
9 ***Austin et al.***

10 United States Patent Application Publication Number US 2003/0191466 A1 published to
11 Austin *et al.* on October 9, 2003 in U.S. class 606 and subclass 54 teaches devices and
12 methods for aligning fragments of a fractured bone or for positioning bones. In some
13 embodiments, fixation devices and anatomical features are modeled with the aid of a
14 computer, and the model is used to determine how an actual fixation device should be
15 configured to align or position the bones.

16 **(26) *United States Patent Application Publication Number US 2003/0225405 A1 to***
17 ***Weiner.***

18 United States Patent Application Publication Number US 2003/0225405 A1 published to
19 Weiner on December 4, 2003 in U.S. class 606 and subclass 54 teaches an external fixator
20 that includes a main body and an outrigger for extending over a fractured joint, such as a
21 wrist joint. The main body can be positioned next to a right arm or flipped over and
22 positioned next to a left arm. The outrigger is attachable to extend either to the left or to
23 the right of the main body, as appropriate. A distal body is removably connectable to the
24 distal end of the main body, and the distal body can be affixed to bone on the opposite side
25 of the fracture to immobilize the joint where the fracture occurs. The distal body is

1 connected to the main body with an adjustable securement section that provides six
2 degrees of adjustment freedom. The outrigger is attached to the main body through a slide
3 plate in a dual rail configuration that provides two dimensions of adjustment. Fragment
4 pin supports ride in a track of the outrigger and provide seven degrees of adjustment
5 freedom for directed fixation of fragments at the fracture site. The major components of
6 the fixator are molded of plastic. A surgical technique using the fixator includes
7 immobilizing the joint for an initial healing duration and retaining fragment pins in place
8 during a secondary healing duration.

9 **(27) *United States Patent Application Publication Number US 2003/0225406 A1 to***
10 ***Weiner et al.***

11 United States Patent Application Publication Number US 2003/0225406 A1 published to
12 Weiner *et al.* on December 4, 2003 in U.S. class 606 and subclass 54 teaches an external
13 fixator that includes a main body and an outrigger for extending over a fractured joint,
14 such as a wrist joint. The main body can be positioned next to a right arm or flipped over
15 and positioned next to a left arm. The outrigger is attachable to extend either to the left or
16 to the right of the main body, as appropriate. A distal body is removably connectable to
17 the distal end of the main body, and the distal body can be affixed to bone on the opposite
18 side of the fracture to immobilize the joint where the fracture occurs. The distal body is
19 connected to the main body with an adjustable securement section that provides six
20 degrees of adjustment freedom. The outrigger is attached to the main body through a slide
21 plate in a dual rail configuration that provides two dimensions of adjustment. Fragment
22 pin supports ride in a track of the outrigger and provide seven degrees of adjustment
23 freedom for directed fixation of fragments at the fracture site. The outrigger is pivotally
24 adjustable relative to the main body and includes track portions separated by a wrap
25 around angle. The major components of the fixator are molded of plastic. A surgical

1 technique using the fixator includes immobilizing the joint for an initial healing duration
2 and retaining fragment pins in place during a secondary healing duration.

3 **(28) *United States Patent Application Publication Number US 2003/0225407 A1 to***
4 ***Estrada, Jr.***

5 United States Patent Application Publication Number US 2003/0225407 A1 published to
6 Estrada, Jr. on December 4, 2003 in U.S. class 606 and subclass 54 teaches a fixator that is
7 an apparatus for repairing fractures of the distal radius and wrist. Distal, pivot, distraction,
8 and radial members provide an anatomically contoured, radiolucent apparatus that permits
9 the wrist to move through a substantially normal range of motion. Apparatus for
10 distraction of the bones by the fixator is also provided. The fixator may be affixed to the
11 lower arm and hand by spaced-apart elongate distal mounting pins with lower ends
12 adapted or mounting in the metacarpal bone and by spaced-apart elongate radial mounting
13 pins with lower ends adapted for mounting in the radius.

14 **(29) *United States Patent Application Publication Number US 2004/0044344 A1 to***
15 ***Winqvist et al.***

16 United States Patent Application Publication Number US 2004/0044344 A1 published to
17 Winqvist *et al.* on March 4, 2004 in U.S. class 606 and subclass 54 teaches an external
18 fixation or adjustable frame structure. A frame structure is retained in any assembled
19 configuration in order to allow final adjustments to be made prior to the final securement
20 of the frame assembly in the precisely desired configuration by closure of each clamp
21 member. In this way, an entire frame assembly is capable of being constructed, adjusted,
22 and readjusted in order to assure each component is oriented in the precisely desired
23 position prior to final closure of the clamping members. In one preferred embodiment, the
24 clamping members employed in the frame structure incorporate friction pins internally
25 mounted in each clamp, and which engage the rod member once this rod is inserted into

1 the jaws of the clamp. In this way, any rod member inserted into the clamping jaws
2 contacts the surface of the jaws and the friction pin preventing the rod member from
3 sliding or moving relative to the clamp. In addition, by incorporating a uniquely
4 constructed, moving wedge plate that is adjustably engageable with any cooperating
5 anchor pin, secure affixation of the mounting member with the anchor pins of any diameter
6 is achieved regardless of the orientation configuration or diameter of the anchor pin.

7 **(30) *United States Patent Number US 6,716,212 B1 to Pickens.***

8 United States Patent Number US 6,716,212 B1 issued to Pickens on April 6, 2004 in U.S.
9 class 606 and subclass 54 teaches a universal modular external fixation system for
10 immobilizing bone fragments in long bone fractures. The universal modular external
11 fixation system includes a frame assembly including a plurality of pins to be coupled to
12 various portions of a fractured bone. The external sections of the pins are fixated to a
13 variety of different coupling devices to attach to a series of connecting bars along the
14 length of the fractured bone. A plurality of connecting members interconnect the
15 connecting bars, thereby securing the pins, and thus the bone sections, to aid in proper
16 healing of the fracture(s).

17 **(31) *United States Patent Application Publication Number US 2004/0097944 A1 to***
18 ***Koman et al.***

19 United States Patent Application Publication Number US 2004/0097944 A1 published to
20 Koman *et al.* on May 20, 2004 in U.S. class 606 and subclass 72 teaches a fixation device
21 for treatment of orthopedic indications. The device, preferably, includes a first portion and
22 a second portion that may be incrementally and independently articulated relative to each
23 other to promote healing of an orthopedic indication. One or more worm gear assemblies
24 may be used to incrementally adjust articulation of the first portion and the second portion
25 relative to each other.

1 **(32) United States Patent Application Publication Number US 2004/0116925 A1 to**
2 **Gill et al.**

3 United States Patent Application Publication Number US 2004/0116925 A1 published to
4 Gill *et al.* on June 17, 2004 in U.S. class 606 and subclass 54 teaches a frame for attaching
5 to a patient, a stereoguide, and a member for attaching to a patient. A method for
6 manufacturing the frame, member, and stereoguide is also provided. The frame, member,
7 and stereoguide are constructed from a composite material including a matrix material and
8 electromagnetically inert fibres.

9 **(33) United States Patent Application Publication Number US 2004/0133199 A1 to**
10 **Coati et al.**

11 United States Patent Application Publication Number US 2004/0133199 A1 published to
12 Coati *et al.* on July 8, 2004 in U.S. class 606 and subclass 54 teaches an external fixation
13 device having a carrying structure of interconnected elements, which includes an
14 extendible central body, and clamps for bone screws, respectively, articulated on opposed
15 ends of the central body. The central body includes two parts telescoping slidable one on
16 the other. Each of the parts include a first portion of elongate shape formed integrally with
17 a second end portion of substantially cylindrical shape. The first portions of the parts are
18 slidably coupled to each other by way of a driving groove formed longitudinally in one
19 first portion and a corresponding slide formed longitudinally in the other first portion, and
20 apparatus is provided in the parts for stopping their sliding movement, which is
21 characterized in that it further includes at least one plate having a predetermined contour
22 shape and thickness, at least one recess formed on the surface of at least one of the
23 interconnected elements and having its contour shape matching the contour shape of the at
24 least one plate, and apparatus for releasably securing the at least one plate in the at least
25 one recess.

1 **(34) *United States Patent Application Publication Number US 2004/0133200 A1 to***
2 ***Ruch et al.***

3 United States Patent Application Publication Number US 2004/0133200 A1 published to
4 Ruch *et al.* on July 8, 2004 in U.S. class 606 and subclass 54 teaches an apparatus to
5 reduce bony fragments and maintain a human's wrist or hand in a healing position. The
6 apparatus may include a first clamp assembly operable to removably mount to an external
7 fixator when the external fixator is coupled to a first bone of a human. A second clamp
8 assembly may be releasably engaged with at least one bone pin embedded in a second bone
9 of a human. A connector rod may be provided to join the first clamp assembly to the
10 second clamp assembly.

11 **(35) *United States Patent Application Publication Number US 2004/0138659 A1 to***
12 ***Austin et al.***

13 United States Patent Application Publication Number US 2004/0138659 A1 published to
14 Austin *et al.* on July 15, 2004 in U.S. class 606 and subclass 54 teaches apparatuses and
15 methods for externally fixing and precisely adjusting fractures, such as fractures near the
16 ankle. In one embodiment, an external fixation apparatus includes a first member
17 attachable to a first bone segment through pins and a second member coupled to the first
18 member through a lockable ball joint. First and second ends of the second member may be
19 translated transversely relative to a longitudinal axis of the second member, and a pin
20 clamp is coupled to and rotatable about the second member through a lockable joint and
21 attachable to a second bone segment. The pin clamp and the second member may be
22 releasably coupled.

23 **(36) *United States Patent Application Publication Number US 2005/0015087 A1 to***
24 ***Walulik et al.***

25 United States Patent Application Publication Number US 2005/0015087 A1 published to
26 Walulik *et al.* on January 20, 2005 in U.S. class 606 and subclass 54 teaches a frame

1 assembly for an external fixation device and associated method. The frame assembly
2 includes a first arc segment and a second arc segment. The first arc segment is for
3 interconnection to a first bone portion. The second arc segment is for interconnection to a
4 second bone portion. The first arc segment is coupled to the second arc segment for
5 controlled relative rotation.

6 **(37) *United States Patent Application Publication Number US 2005/0038425 A1 to***
7 ***Werding et al.***

8 United States Patent Application Publication Number US 2005/0038425 A1 published to
9 Werding *et al.* on February 17, 2005 in U.S. class 606 and subclass 54 teaches a device for
10 externally immobilizing broken bones, particularly, bones of the extremities. Interspaced
11 bone pins provided for insertion into the bone while passing through the skin and soft-
12 tissue mantle are arranged on a multi-articulation rod. This multi-articulation rod can be
13 placed on the outside of the body while extending along a broken bone, and includes
14 elements that are interconnected in a ball-and-socket type manner, which can be fixed in
15 selected relative positions. The elements have a ball on one end and a ball socket on the
16 other end. The ball of one element is located inside the ball socket of an adjacent element.
17 The ball and ball socket each geometrically extend over more than one hemisphere, and
18 the surfaces of the ball and ball socket are roughened.

19 **(38) *United States Patent Application Publication Number US 2005/0085810 A1 to***
20 ***Lutz et al.***

21 United States Patent Application Publication Number US 2005/0085810 A1 published to
22 Lutz *et al.* on April 21, 2005 on U.S. class 606 and subclass 54 teaches an external fixation
23 system having clamps, rods, and pins having anti-magnetic core parts and a non-
24 conductive sheath part covering essentially the exterior surfaces of the core part. The rods,
25 pins, and clamps are especially MRI safe for a patient when used in any frame

1 configuration for fractures of the upper and lower extremities and pelvis. The usual MRI
2 field parameters of a static field of 2 Tesla, a time-varying field of max. 20 Tesla/sec, and a
3 specific absorption rate (SAR) of max. 0.4 Watts/kg averaged over the whole body of the
4 patient apply.

5 **(39) *United States Patent Application Publication Number US 2005/0085811 A1 to***
6 ***Peckitt.***

7 United States Patent Application Publication Number US 2005/0085811 A1 published to
8 Peckitt on April 21, 2005 in U.S. class 606 and subclass 55 teaches a spiral distraction
9 device including anchoring apparatus for attachment of the device to each side of a
10 patient's existing mandible. A conjoined intermediate bar attaches to and transports
11 moveable bone pieces on each side of the patient's mandible towards each other in a spiral
12 vector that is larger than the patient's anatomical mandible contour.

13 **(40) *International Patent Application Publication Number WO/2005/044117 to***
14 ***Biedermann et al.***

15 International Patent Application Publication Number WO/2005/044117 published to
16 Biedermann *et al.* on May 19, 2005 in international patent class A61B 17/70 teaches an
17 elastic element that is used in a stabilizing device for bones or vertebrae. The elastic
18 element is embodied as a substantially cylindrical member having a first end and an
19 opposite second end. At least one of the opposite ends of the cylindrical member is
20 provided with a coaxial bore that includes a female thread that is connected to a shaft
21 and/or a head of a bone screw or rod section.

22 **(41) *United States Patent Application Publication Number US 2005/0113829 A1 to***
23 ***Walulik et al.***

24 United States Patent Application Publication Number US 2005/0113829 A1 published to
25 Walulik *et al.* on May 26, 2005 in U.S. class 606 and subclass 54 teaches an external

1 fixation device that includes a frame assembly having a first arc segment and a second arc
2 segment. The first arc segment is for interconnection to a first bone portion. The second
3 arc segment is for interconnection to a second bone portion. The first arc segment is
4 coupled to the second arc segment for relative rotation. The external fixation assembly
5 additionally includes an articulating module. The articulating module includes a central
6 member, a first pivot segment, and a second pivot segment. The first pivot segment is
7 coupled to the central member for driven rotation about a first pivot axis. The second
8 pivot segment is coupled to the central member for driven rotation about a second pivot
9 axis. The second pivot axis is substantially perpendicular to the first pivot axis.

10 **(42) *United States Patent Number US 6,908,467 B2 to Ip et al.***

11 United States Patent Number US 6,908,467 B2 issued to Ip *et al.* on June 21, 2005 in U.S.
12 class 606 and subclass 72 teaches a fixation device for internally or externally fixing
13 fractures, which includes at least one nitinol wire having an S-shaped section and two
14 ends. Each of the two ends forms a hook for hooking into a bone section of a fractured
15 bone. This device can be made from nitinol that has a transformation temperature between
16 25° C. and 35° C. In addition, this device can have a diameter between 0.6 mm and 5 mm.
17 The device can be inserted using the following process that starts by cooling the wire
18 below a transfer temperature so that the nitinol wire forms in a martensite state. Next, the
19 nitinol wire is inserted into an interphalangeal bone underneath a patient's skin. Next, the
20 nitinol wire heats up inside a patient's body above the transfer temperature. Finally, the
21 wire transforms from a martensite state to an austenite state wherein the nitinol wire
22 elongates in a longitudinal direction to generate a distraction force.

23 **(43) *United States Patent Application Publication Number US 2005/0149018 A1 to***
24 ***Cooper et al.***

1 United States Patent Application Publication Number US 2005/0149018 A1 published to
2 Cooper *et al.* on July 7, 2005 in U.S. class 606 and subclass 54 teaches an external
3 foot/ankle fixation device having a one-piece frame component and a positionable cross
4 bar that allows the attachment of generally anterior/posterior directed fixation wires or
5 rods emanating from the foot/ankle of a patient. The external fixation device provides a
6 stable fixation platform, both in-plane and out-of-plane of the object of fixation, *e.g.* foot
7 or ankle. The fixation device through the cross bar also provides various degrees of
8 angulation of anterior/posterior directed wires in two planes. Posterior angulation
9 components may be provided to the posterior portion of the frame component, which
10 provide additional fixation wire/rod angulation variations. Compression rails may also be
11 provided. An optional elevator component may be attached to the bottom of the frame
12 component, which does not obstruct access to the soft tissues on the bottom of the foot.
13 The elevator component protects the bottom of the foot from contaminated surfaces.

14 **(44)** *United States Patent Application Publication Number US 2005/0165394 A1 to*
15 *Boyce et al.*

16 United States Patent Application Publication Number US 2005/0165394 A1 published to
17 Boyce *et al.* on July 28, 2005 in U.S. class 606 and subclass 54 teaches a method of and
18 system for attaching an orthopedic member to bone. The orthopedic member is positioned
19 with respect to a bone segment. A plurality of pins are then driven through the orthopedic
20 member and into the bone segment to secure the orthopedic member to the bone segment.

21 **(45)** *United States Patent Application Publication Number US 2005/0203509 A1 to*
22 *Chinnaian et al.*

23 United States Patent Application Publication Number US 2005/0203509 A1 published to
24 Chinnaian *et al.* on September 15, 2005 in U.S. class 606 and subclass 54 teaches a
25 fixation device employed to affix two or more segments of bone in a desired spatial

1 relationship. Embodiments of the fixation device secure and maintain a bone fracture or
2 fractures in proper alignment during the healing process, as well as permit slight
3 movement or micro-motion therebetween to promote healing. In some applications,
4 embodiments of the fixation device place the bone segments under continuous and
5 adjustable compression or distraction, while still allowing slight movement or micro-
6 motion at the bone segment interface.

7 **(46) *United States Patent Application Publication Number US 2005/0234452 A1 to***
8 ***Malandain.***

9 United States Patent Application Publication Number US 2005/0234452 A1 published to
10 Malandain on October 20, 2005 in U.S. class 606 and subclass 61 teaches an implantable
11 medical device and methods of use thereof for supporting a structure. The structure
12 supported can include a bony structure. The device includes a support element having a
13 top portion, and a bottom portion having a bottom surface and one or more apertures
14 passing therethrough. The bottom surface of the support element includes a receiver
15 configured to receive a plurality of anchor assemblies. Each of the anchor assemblies
16 includes apparatus for locking the anchor assembly to the support element, and a base
17 having a head and apparatus for locking the base to the anchor assembly. When
18 assembled, the head of the base for the anchor assembly may not pass through the support
19 element.

20 **(47) *United States Patent Application Publication Number US 2005/0251135 A1 to***
21 ***Riccione et al.***

22 United States Patent Application Publication Number US 2005/0251135 A1 published to
23 Riccione *et al.* on November 10, 2005 in U.S. class 606 and subclass 54 teaches an
24 external fixation assembly for bone fusion. The assembly includes an extension arm
25 having a fixation joint portion and a pin element moveably disposed along the extension

1 arm defining a first joint portion. The assembly further includes a plurality of connecting
2 pins for bone fusion. Each of the connecting pins is configured to engage with bone matter
3 for bone fusion and to singly attach to one of the joint portions for support.

4 **(48) *United States Patent Application Publication Number US 2006/0015101 A1 to***
5 ***Warburton et al.***

6 United States Patent Application Publication Number US 2006/0015101 A1 published to
7 Warburton *et al.* on January 19, 2006 in U.S. class 606 and subclass 62 teaches an
8 intramedullary fixation assembly usable with different long bone types and a guide
9 assembly for guiding deployment of the intramedullary fixation assembly. The
10 intramedullary fixation assembly includes a fixation member that has ends and a curved
11 body extending between the ends. The curved body of the fixation member has a radius of
12 curvature configured to extend through the medullary canal regardless of the long bone
13 anatomy. Fasteners fix the fixation member to the bone fragments and are guided by a
14 guide assembly. The guide assembly includes a guide body defining openings configured
15 to guide the fasteners through openings defined in the fixation member and into the bone
16 fragments. A fixation end of the guide body includes a pair of opposing, converging
17 surfaces that are configured to engage in a positive fit, with an exposed end of the fixation
18 member accessible through the side aperture in the first fragment.

19 **(49) *International Patent Application Publication Number WO/2006/068682 to***
20 ***Greenhalgh et al.***

21 International Patent Application Publication Number WO/2006/068682 published to
22 Greenhalgh *et al.* on June 29, 2006 in international patent class A61B 17/60 teaches an
23 expandable support device and methods of using the expandable support device. The
24 expandable support device can be rotatably and inflatably deployed by a deployment tool.
25 The deployment tool can engage a notch on the expandable support device and deliver a

1 torque to the expandable support device. The deployment tool can inflate and expand the
2 expandable support device.

3 **(50)** *United States Patent Application Publication Number US 2006/0184169 A1 to*
4 *Stevens.*

5 United States Patent Application Publication Number US 2006/0184169 A1 published to
6 Stevens on August 17, 2006 in U.S. class 606 and subclass 54 teaches a system for
7 stabilizing bone. The system includes a fixing block, a pin having a far end that is adapted
8 to be fixed directly into bone and a near end that enters the fixing block, and a frame on
9 which the fixing block is fixable. The pin enters the fixing block in a non-orthogonal
10 manner in order to permit the pin to enter the bone with an orientation that is non-
11 orthogonal to the bone's surface, thereby permitting the pin to engage more of the bone.

12 **(51)** *International Patent Application Publication Number WO/2006/092863 to*
13 *Nakamura et al.*

14 International Patent Application Publication Number WO/2006/092863 published to
15 Nakamura *et al.* on September 8, 2006 in international patent class A61B 17/60 teaches an
16 external wound fixing device that allows a bone and a bone piece to be moved freely and
17 deformation thereof to be corrected. The external wound fixing device includes a pair of
18 holding members for holding/securing rod-like members that are inserted, respectively,
19 into a first part and a second part of a bone on opposite sides of a virtual fulcrum, and a
20 coupling member for coupling the holding members. The virtual fulcrum is determined by
21 any one of the center of deformation, the center of rotation of bone pieces holding a
22 fracture part or a correction bone cut part between them, and the movable center of a joint
23 part. The coupling member has a pair of arms fixed rotatably to one end of each of the
24 holding members, respectively, and the pair of arms are coupled rotatably. Rotational axes
25 of these arms are directed toward the virtual fulcrum.

1 **(52) *United States Patent Application Publication Number US 2006/0217710 A1 to***
2 ***Abdou.***

3 United States Patent Application Publication Number US 2006/0217710 A1 published to
4 Abdou on September 28, 2006 in U.S. class 606 and subclass 54 teaches skull fixation
5 assemblies and corresponding components. The assemblies include a multi-axial occipito-
6 cervical connection system that enables elongate interconnectors, such as rods, to be
7 coupled in a manner that permits relative movement in one or more planes. The system
8 includes a locking mechanism that can be actuated to lock the relative positions of the
9 elongate interconnector.

10 **(53) *United States Patent Application Publication Number US 2006/0235383 A1 to***
11 ***Hollawell.***

12 United States Patent Application Publication Number US 2006/0235383 A1 published to
13 Hollawell on October 19, 2006 in U.S. class 606 and subclass 54 teaches a fixator for use
14 in the reconstruction of acute, chronic, and traumatic injuries to the upper and lower
15 extremities. The fixator has a clamping system that allows for the snapping in of pins and
16 rails, and for multi-planar fixation of bones.

17 **(54) *United States Patent Application Publication Number US 2006/0271043 A1 to***
18 ***Gonzalez.***

19 United States Patent Application Publication Number US 2006/0271043 A1 published to
20 Gonzalez on November 30, 2006 in U.S. class 606 and subclass 55 teaches a user-attached,
21 manually operated, fluid-driven arm lift device for people who have difficulties in lifting
22 an arm unassisted, which includes a base support member adapted to fit about a portion of
23 a side rib area of a human, a base support member attachment mechanism connected to the
24 base support member and adapted to removably attach the base support member to the
25 human, an arm support member having a top end and having a bottom end and being
26 hingedly connected to the base support member at its top end, a fluid-driven piston

1 cylinder and drive rod system connected to the base support member at the system bottom
2 end and to the arm support member at system top end, a manually operated fluid pump and
3 a fluid reservoir, and a fluid release mechanism.

4 **(55) *United States Patent Application Publication Number US 2007/0038217 A1 to***
5 ***Brown et al.***

6 United States Patent Application Publication Number US 2007/0038217 A1 published to
7 Brown *et al.* on February 15, 2007 in U.S. class 606 and subclass 57 teaches an
8 orthopaedic fixation clamp for use in an external fixation system and its method of use.

9 **(56) *United States Patent Application Publication Number US 2007/0055233 A1 to***
10 ***Brinker.***

11 United States Patent Application Publication Number US 2007/0055233 A1 published to
12 Brinker on March 8, 2007 in U.S. class 606 and subclass 54 teaches a system for externally
13 repairing fractured bones and facilitating alignment of displaced fractured bone segments
14 without requiring use of an external ring fixator system and tension wires. The system
15 includes at least one panel member having a plurality of apertures extending from a first
16 side to a second side of the panel member. At least two pin carriers are capable of being
17 inserted into at least two of the plurality of apertures in the at least one panel member. The
18 pin carriers, upon insertion into one of the plurality of apertures in the panel member, are
19 longitudinally fixed relative to the aperture, but capable of rotation within the aperture. At
20 least two half-pins are capable of insertion into a pin carrier, following insertion of the one
21 pin carrier into one of the plurality of apertures provided in the panel member, toward
22 subsequent securement to a fractured bone segment. Rotation of a pin carrier causes an
23 associated half-pin inserted therein to move longitudinally with respect to the panel
24 member to, in turn, reposition the fractured bone segment affixed to the half-pin, relative
25 to the panel member.

1 **(57)** *International Patent Application Publication Number WO/2007/053887 to*
2 *Allison.*

3 International Patent Application Publication Number WO/2007/053887 published to
4 Allison on May 18, 2007 in international patent class A61B 17/60 teaches an external
5 fixator for assisting healing of a fracture in a bone, which comprises a securing portion that
6 defines a void, and an elongate bracket portion extends from the securing portion. The
7 bracket portion is arranged to engage one or more first percutaneous bone fasteners
8 locatable in the bone on a first side of the fracture. In use, one or more second
9 percutaneous fasteners are located in the bone on a second side of the fracture so that the
10 second fasteners extend into the void of the securing portion. The void can be filled with a
11 cement compound to secure the second bone fasteners in place with respect to the securing
12 portion.

13 **(58)** *United States Patent Application Publication Number US 2007/0118116 A1 to*
14 *Feiler et al.*

15 United States Patent Application Publication Number 2007/0118116 A1 published to
16 Feiler *et al.* on May 24, 2007 in U.S. class 606 and subclass 54 teaches a surgical
17 appliance for assisting in the repair of a fractured bone, such as a scaphoid bone. The
18 device includes first and second adjustably interconnected and spaced apart limb clamping
19 jaws that are transparent to x-ray radiation and are relatively movable toward and away
20 from one another, and a rotatable disk carried by the first jaw. The disk has a plurality of
21 bores angularly disposed therein for selectively aligning a guide wire to be drilled
22 percutaneously into the fractured bone. Each of the bores are in communication with the
23 space between the first and second jaws, and the longitudinal axes of the bores are directed
24 to a common point intermediate the first and second jaws.

1 **(59) *United States Patent Application Publication Number US 2007/0123858 A1 to***
2 ***Strub et al.***

3 United States Patent Application Publication Number 2007/0123858 A1 published to Strub
4 *et al.* on May 31, 2007 in U.S. class 606 and subclass 54 teaches an external fixation
5 device having a frame including at least one rod that takes up mechanical loads. The
6 frame and bone are connected via connecting apparatus, known *per se*, in particular bone-
7 retaining pins. This connecting apparatus in turn is connected to the frame via clamping
8 jaws. These clamping jaws permit detachable fixing and arbitrary arrangement and
9 grouping on the frame. A module can be mounted on the frame. By way of the module, a
10 movement of two bone fragments relative to one another can be effected. It has at least
11 two components. The first of the at least two components can be connected to the frame.
12 The second of the at least two components can be connected to at least one clamping jaw
13 of a connecting apparatus that is connected to a bone fragment.

14 **(60) *United States Patent Application Publication Number US 2007/0161983 A1 to***
15 ***Cresina et al.***

16 United States Patent Application Publication Number US 2007/0161983 A1 published to
17 Cresina *et al.* on July 12, 2007 in U.S. class 606 and subclass 54 teaches an external
18 fixation system for a bone and associated method. The fixation system includes a proximal
19 frame defining a continuous proximal boundary, a distal frame defining a continuous distal
20 boundary, and at least one frame connector configured for interconnecting the proximal
21 and distal frames at any position along at least one of the proximal and distal boundaries.

22 **(61) *International Patent Application Publication Number WO/2007/090543 to***
23 ***Wolter et al.***

24 International Patent Application Publication Number WO/2007/090543 published to
25 Wolter *et al.* on August 16, 2007 in international patent class A61B 17/60 teaches a
26 fixation system for bone, which includes a connecting support, at least one bone screw that

1 can be inserted into a through bore of the connecting support, and a sensor and telemetry
2 system. The sensor and telemetry system is arranged on a separate plate that can be joined
3 to the connecting support.

4 **(62) *United States Patent Application Publication Number US 2007/0255280 A1 to***
5 ***Austin et al.***

6 United States Patent Application Publication Number US 2007/0255280 A1 published to
7 Austin *et al.* on November 1, 2007 in U.S. class 606 and subclass 54 teaches apparatuses
8 and methods for externally fixing and precisely adjusting fractures, such as fractures near
9 the ankle. In one embodiment, an external fixation apparatus includes a first member
10 attachable to a first bone segment through pins, and a second member coupled to the first
11 member through a lockable ball joint. First and second ends of the second member may be
12 translated transversely relative to a longitudinal axis of the second member. A pin clamp
13 is coupled to and rotatable about the second member through a lockable joint and
14 attachable to a second bone segment. The pin clamp and the second member may be
15 releasably coupled.

16 **(63) *United States Patent Application Publication Number US 2007/0260243 A1 to***
17 ***Kagami.***

18 United States Patent Application Publication Number US 2007/0260243 A1 published to
19 Kagami on November 8, 2007 in U.S. class 606 and subclass 57 teaches a tower-shaped
20 frame provided to stand upright on a positionable platform, and a bone correction rod held
21 by an elevating supporter. The elevating supporter is mounted on the tower-shaped frame
22 to be adjustably movable up and down. A bone correction rod and a weight receiver are
23 suspended from the elevating supporter to be movable up and down so as to apply a load of
24 weights to the bone correction element as a bone correction force. When the bone
25 correction device is used, a height of the elevating supporter is adjusted depending on a

1 size, a posture of a body of a patient, and a position of the patient, and so forth, and a
2 necessary weight is placed on the weight receiver depending on the symptom of the
3 patient, and so forth. When the bone correction element is applied to an affected part, a
4 pressing force is applied to the affected part in proportion to the weights, and hence if the
5 pressing force is continuously applied to the affected part, an obstinate strain of a physique
6 can be corrected.

7 **(64)** *International Patent Application Publication Number WO/2007/138659 to Hirata*
8 *et al.*

9 International Patent Application Publication Number WO/2007/138659 published to Hirata
10 *et al.* on December 6, 2007 in international patent class A61B 17/60 teaches an external
11 fixator for imparting extremely high degrees of freedom to insertion directions of pins.
12 The fixator is provided with a plural number of pins to be inserted into a bone, ball joints
13 to be, respectively, connected to these pins, and a rod-shaped member having a plural
14 number of connectors for connecting the ball joints together. The rod-shaped member
15 enables the adjustment of the positions of the connectors at least in the longitudinal
16 direction of the rod-shaped member.

17 **(65)** *United States Patent Application Publication Number US 2008/0021451 A1 to*
18 *Coull et al.*

19 United States Patent Application Publication Number US 2008/0021451 A1 published to
20 Coull *et al.* on January 24, 2008 in U.S. class 606 and subclass 54 teaches an external
21 fixator for treating a fracture of a long bone, which has six extension arms that are
22 extendable out of and retractable into a main body. The six extension arms are arranged
23 into two sets of three, with each set of three extension arms being able to support a fixation
24 ring. Each extension arm is pivotable at a joint and extendable so as to allow the ring to be
25 set at a wide range of angular positions relative to the main body. The three extension

1 arms and the ring each define a wrap angle about the axis of the long bone being treated.
2 The longitudinal position of each extension arm can be changed either with a coarse
3 adjustment capability or with a fine adjustment capability, with the coarse adjustment
4 capability being through rotation of a thumb wheel. The six extension arms are also
5 arranged into three opposing pairs, with each pair of extension arm shafts being disposed
6 in an abutting relationship in the main body so that the extension arm shafts extend or
7 retract out opposing sides of the main body.

8 **(66) *United States Patent Application Publication Number US 2008/0086123 A1 to***
9 ***Gotfried.***

10 United States Patent Application Publication Number US 2008/0086123 A1 published to
11 Gotfried on April 10, 2008 in U.S. class 606 and subclass 59 teaches apparatus and method
12 for treating a bone of a body of a patient, which includes a first member, at least a portion
13 of which is radiolucent and arranged to be attached to the bone, an attachment member for
14 attaching the first member to the bone, and a second member, at least a portion of which is
15 radiolucent and arranged at least partly outside of the body of the patient and coupled to
16 the first member. The second member guides the attachment member to facilitate
17 attachment of the first member to the bone via the attachment member. The partially
18 radiolucent composition of the first and second members facilitates attachment of the first
19 member to the bone while imaging the apparatus, *i.e.*, subjecting the apparatus and bone to
20 X-ray imaging.

21 **(67) *United States Patent Application Publication Number US 2008/0091203 A1 to***
22 ***Warburton et al.***

23 United States Patent Application Publication Number US 2008/0091203 A1 published to
24 Warburton *et al.* on April 17, 2008 in U.S. class 606 and subclass 62 teaches an
25 intramedullary fixation assembly usable with different long bone types, and a guide

1 assembly for guiding deployment of the intramedullary fixation assembly. The
2 intramedullary fixation assembly includes a fixation member that has ends and a curved
3 body extending between the ends. The curved body of the fixation member has a radius of
4 curvature configured to extend through the medullary canal, regardless of the long bone
5 anatomy. Fasteners fix the fixation member to the bone fragments and are guided by a
6 guide assembly. The guide assembly includes a guide body defining openings configured
7 to guide the fasteners through openings defined in the fixation member and into the bone
8 fragments. A fixation end of the guide body includes a pair of opposing, converging
9 surfaces that are configured to engage in a positive fit, with an exposed end of the fixation
10 member accessible through the side aperture in the first fragment.

11 **(68) *International Patent Application Publication Number WO/2008/051064 to***
12 ***Anguiano.***

13 International Patent Application Publication Number WO/2008/051064 published to
14 Anguiano on May 2, 2008 in international patent classification A61B 17/60 teaches an all-
15 metal device made from preformed elements welded to two basic sections that provide a
16 lengthening or retraction effect as required, and which once assembled, operate
17 telescopically. The device is for use in plastic, reconstructive, and trauma surgery on the
18 hand or the metacarpal and metatarsal phalanges. The device can be locked using a variety
19 of readily-available elements.

20 **(69) *International Patent Application Publication Number WO/2008/073238 to***
21 ***Cresina et al.***

22 International Patent Application Publication Number WO/2008/073238 published to
23 Cresina *et al.* on June 19, 2008 in international patent classification A61B 17/64 teaches an
24 external fixation system for a joint having a first and second bone and defining an
25 anatomical axis of rotation. The fixation system can include a proximal frame couplable to

1 the first bone and a distal frame couplable to the second bone. A first connector can
2 include a first member pivotally coupled to a second member at a first pivot axis. A
3 second connector can include a third member pivotally coupled to a fourth member at a
4 second pivot axis. The first and second connectors are mountable between the proximal
5 and distal frames at a location so that the first and second pivot axes are coaxial with the
6 anatomical axis of rotation.

7 **(70) *United States Patent Application Publication Number US 2008/0188852 A1 to***
8 ***Matityahu.***

9 United States Patent Application Publication Number US 2008/0188852 A1 published to
10 Matityahu on August 7, 2008 in U.S. class 606 and subclass 54 teaches a medical
11 apparatus and a method of use for use with an outrigger and at least one fastening pin to
12 reposition first and second portions of a bone of a mammalian body. The apparatus
13 includes a framework and a first fastening assembly for coupling the framework to the
14 outrigger, and thus the at least one fastening pin and the first end portion of the bone. The
15 first end portion of an elongate pin is provided with a sharpened tip for penetrating the
16 second portion of the bone. A second fastening assembly couples the second end portion
17 of the elongate pin to the framework. At least one adjustment assembly is carried by at
18 least one of the framework and the first and second fastening assemblies for moving the
19 first end portion of the elongate pin relative to the outrigger so as to reposition the second
20 portion of the bone relative to the first portion of the bone.

21 **(71) *United States Patent Application Publication Number US 2008/0195095 A1 to***
22 ***Renard et al.***

23 United States Patent Application Publication Number US 2008/0195095 A1 published to
24 Renard *et al.* on August 14, 2008 in U.S. class 606 and subclass 54 teaches resilient
25 external fixators between first and second bone portions. The fixator includes a helical

1 spring having an axis, a body, first apparatus for mounting the body to co-operate with the
2 spring so that the spring is suitable for turning relative to the body about the axis, a pin of
3 axis suitable for being fastened on the bone, apparatus for mounting the pin to cooperate
4 with the body so as to pass through the spring and so that the axis forms a non-zero angle
5 with the axis, another body, and apparatus for connecting the body with the bone and the
6 spring. The fixator is applicable specifically to external fixators for fingers.

7 **(72) United States Patent Application Publication Number US 2008/0221571 A1 to**
8 **Daluiski et al.**

9 United States Patent Application Publication Number US 2008/0221571 A1 published to
10 Daluiski *et al.* on September 11, 2008 in U.S. class 606 and subclass 54 teaches an
11 orthopedic external fixation system that may include a distal bar having a curvature that
12 varies along its length, an uncurved proximal bar, a plurality of proximal embedding
13 members, and a plurality of distal embedding members. The proximal and the distal
14 embedding members, sized and shaped for embedding in bone, may attach directly or
15 indirectly to the proximal bar and the distal bar, respectively.

16 **(73) United States Patent Application Publication Number US 2008/0221572 A1 to**
17 **Naegerl et al.**

18 United States Patent Application Publication Number US 2008/0221572 A1 published to
19 Naegerl *et al.* on September 11, 2008 in U.S. class 606 and subclass 57 teaches a device
20 for temporary fixation of parts of a human joint, which includes two holding elements
21 disposed opposite one another and a releasable fixing device configured to fix in place a
22 respective joint part of the human joint between the two holding elements. In addition, the
23 device includes a support surface configured to support a distal joint part and a proximal
24 joint part, a guide configured to position and to limit a relative movement of at least one of
25 a surgical instrument and a surgical aid, and receiving apparatus for receiving the guide.

1 **(74) United States Patent Application Publication Number US 2008/0221573 A1 to**
2 **Kumhyr.**

3 United States Patent Application Publication Number US 2008/0221573 A1 published to
4 Kumhyr on September 11, 2008 in U.S. class 606 and subclass 59 teaches an adjustment
5 device for an external fixator, which has an elongated fixator body connected to bone-pin
6 clamps at proximal and distal ends of the elongated fixator body. The adjustment device
7 includes at least one adaptor for mounting to at least one of the bone-pin clamps. The
8 adaptor stabilizes the bone-pins during an adjustment of the fractured bone to lessen the
9 amount of pain experienced by a patient. An adjustment knob may be coupled to the
10 adaptor and used to tighten or loosen a portion of the bone-pin clamp that facilitates
11 rotation of the bone-pin clamp.

12 **(75) United States Patent Application Publication Number US 2008/0255554 A1 to**
13 **Richter et al.**

14 United States Patent Application Publication Number US 2008/0255554 A1 published to
15 Richter *et al.* on October 16, 2008 in U.S. class 606 and subclass 57 teaches an external
16 fixator having a retaining member and connecting elements that can be connected, without
17 screws, to a bone or bone parts, in particular to both halves of an opened sternum, and
18 provide for increasing or reducing the compressive stress between the two bone parts or
19 sternum halves.

20 **(76) United States Patent Application Publication Number US 2008/0269741 A1 to**
21 **Karidis.**

22 United States Patent Application Publication Number US 2008/0269741 A1 published to
23 Karidis on October 30, 2008 in U.S. class 606 and subclass 56 teaches an orthopedic
24 fixator for positioning a first element relative to a second element with controlled
25 compliance that can be adjusted during the healing process. One embodiment includes a
26 first frame for attachment to the first element, a second frame attached to the first frame

1 through a plurality of adjustable effective length struts, and a third frame for attachment to
2 the second element. The third frame is compliantly attached to the second frame. A
3 preferred embodiment includes adjustable-length preload elements to apply unidirectional
4 forces between the first and second frames so as to preload the adjustable effective length
5 struts and substantially reduce the positional tolerance. An alternative embodiment
6 includes adjustable spring elements allowing the compliance of the attachment of the third
7 frame to the second frame to be adjusted at various points in the healing process.

8 **(77) *United States Patent Application Publication Number US 2008/0281324 A1 to***
9 ***Webb et al.***

10 United States Patent Application Publication Number US 2008/0281324 A1 published to
11 Webb *et al.* on November 13, 2008 in U.S. class 606 and subclass 59 teaches an external
12 fixation assembly that includes a plurality of hollow pins that are inserted into a patient's
13 bone. Each pin has an interior bore and a plurality of apertures extending through the pin
14 wall from the bore. The pin may be coupled to a source of vacuum pressure operable to
15 create reduced pressure in the tissue surrounding the pin. A cover is placed around the pin
16 and sealed to provide a fluid-tight enclosure that maintains reduced pressure around the
17 pin. A method for applying external fixation using the fixator pins includes the steps of
18 inserting each pin through a skin opening, positioning the pin apertures near selected
19 tissue, covering the skin opening with a sealed enclosure, connecting the pins to a source
20 of vacuum pressure, and activating the source of vacuum pressure to create reduced
21 pressure in the patient's tissue at or near the bone.

22 **(78) *United States Patent Application Publication Number US 2009/0018541 A1 to***
23 ***Lavi.***

24 United States Patent Application Publication Number US 2009/0018541 A1 published to
25 Lavi on January 15, 2009 in U.S. class 606 and subclass 59 teaches a clamp for an external

1 fixation system that includes a body having a bottom portion and semi-spherical top
2 portion. The top portion has a threaded bore provided along a longitudinal axis. The
3 clamp includes a clamp assembly having a base with a semi-spherical cavity and a lid
4 positioned over the base to house at least one pin between the base and the lid. The base
5 and the lid have a bore provided along a longitudinal axis thereof. A fastening member
6 extends through the bore in the base and the lid of the clamp assembly and is secured
7 within the threaded bore of the top portion of the body. The bores in the base and the lid
8 have a diameter that is greater than the diameter of the fastening member.

9 **(79)** *United States Patent Application Publication Number US 2009/0024128 A1 to*
10 *Nakamura et al.*

11 United States Patent Application Publication Number US 2009/0024128 A1 published to
12 Nakamura *et al.* on January 22, 2009 in U.S. class 606 and subclass 54 teaches an external
13 skeletal fixation device that reduces load on the patient, is capable of freely moving, and
14 deformity correction of a bone and bone fragments. The external skeletal fixation device
15 includes a pair of pin clamp units fixedly holding rodlike members inserted, respectively,
16 into a first part and a second part of a bone on the opposite sides, respectively, of a virtual
17 hinge point in the bone. The virtual hinge point corresponds to a center of rotational
18 angulation of the bone, a center on which the first and the second part of the bone,
19 respectively, on the opposite sides of a fracture site of the bone or a part of the osteotomy
20 site for deformity correction are turned, or a center about which a joint turns. A
21 connecting mechanism connecting the pair of pin clamp units has a pair of arms pivotally
22 connected to the pair of pin clamp units, respectively. The pair of arms are pivotally
23 joined together. The respective axes of rotary joints, respectively, connect the pin clamp
24 units and the arm, and the arms extend toward the virtual hinge point.

1 **(80) *United States Patent Application Publication Number US 2009/0036889 A1 to***
2 ***Callender.***

3 United States Patent Application Publication Number US 2009/0036889 A1 published to
4 Callender on February 5, 2009 in U.S. class 606 and subclass 55 teaches a method and
5 apparatus for treatment of sleep apnea, which employs bone screws implanted into a
6 patient's anterior maxillary bone above and posterior to the cuspids, and posterior
7 mandibular bone below and between any of the posterior teeth. Elastics are stretched
8 between the maxillary and mandibular bone screws to exert forces to bias the mandible
9 forward with respect to the maxilla. An aligner can be placed between the patient's upper
10 and lower to help maintain proper positioning of the mandible.

11 **(81) *United States Patent Application Publication Number US 2009/0036891 A1 to***
12 ***Brown et al.***

13 United States Patent Application Publication Number US 2009/0036891 A1 published to
14 Brown *et al.* on February 5, 2009 in U.S. class 606 and subclass 57 teaches an orthopaedic
15 fixation clamp for use in an external fixation system and its method of use.

16 **(82) *United States Patent Application Publication Number US 2009/0088751 A1 to***
17 ***Mullaney.***

18 United States Patent Application Publication Number US 2009/0088751 A1 published to
19 Mullaney on April 2, 2009 in U.S. class 606 and subclass 59 teaches clamping devices and
20 methods for external fixation systems, which include a post component having a yaw axis,
21 and a clamping system secured to the post component and rotatable about the yaw axis.
22 The clamping system includes an outer jaw and an inner jaw having an inner surface
23 facing the outer jaw. The outer and inner jaws together form an opening for receiving a
24 fixation element of the external fixation system. The inner jaw and outer jaw have a roll
25 axis alignable with a longitudinal axis of the fixation element. The clamping system and
26 post component are rotatable about the roll axis. The inner jaw also includes a cylindrical

1 outer-facing surface. The devices also include a base component having a cylindrical
2 concave surface having a pitch axis. The concave surface of the base component
3 interfaces with the cylindrical outer facing component on the inner jaw. The outer and
4 inner jaws are rotatable relative to the base and the post component about the pitch axis.

5 **(83) *United States Patent Application Publication Number US 2009/0099565 A1 to***
6 ***Weiner et al.***

7 United States Patent Application Publication Number US 2009/0099565 A1 published to
8 Weiner *et al.* on April 16, 2009 in U.S. class 606 and subclass 54 teaches an external
9 fixator that includes a main body and an outrigger for extending over a fractured joint,
10 such as a wrist joint. The main body can be positioned next to a right arm or flipped over
11 and positioned next to a left arm. The outrigger is attachable to extend either to the left or
12 to the right of the main body, as appropriate. A distal body is removably connectable to
13 the distal end of the main body and can be affixed to bone on the opposite side of the
14 fracture to immobilize the joint where the fracture occurs. The distal body is connected to
15 the main body with an adjustable securement section that provides six degrees of
16 adjustment freedom. The outrigger is attached to the main body through a slide plate in a
17 dual rail configuration that provides two dimensions of adjustment. Fragment pin supports
18 ride in a track of the outrigger and provide seven degrees of adjustment freedom for
19 directed fixation of fragments at the fracture site. The outrigger is pivotally adjustable
20 relative to the main body and includes track portions separated by a wrap around angle.
21 The major components of the fixator are molded of plastic. A surgical technique using the
22 fixator includes immobilizing the joint for an initial healing duration and retaining
23 fragment pins in place during a secondary healing duration.

24 It is apparent that numerous innovations for fixators have been provided in the
25 prior art, which are adapted to be used. Furthermore, even though these innovations may

1 be suitable for the specific individual purposes to which they address, however, they would
2 not be suitable for the purposes of the embodiments of the present invention as heretofore
3 described.

1 **2. Summary of the invention.**

2 Thus, an object of the embodiments of the present invention is to provide a dynamic
3 external fixator, which avoids disadvantages of the prior art.

4 Briefly stated, another object of the embodiments of the present invention is to
5 provide an orthopedic apparatus for bridging between a first bone unit and a second bone
6 unit of at least one of an injured bone and/or of an injured joint for one of distraction,
7 compression, static placement and/or relative rotation of the at least one of the bones and
8 the joint, and method of implanting and/or using the apparatus. The apparatus includes a
9 first attaching apparatus, a second attaching apparatus, and a control apparatus. The first
10 attaching apparatus connects the apparatus to the first bone unit. The second attaching
11 apparatus connects the apparatus to the second bone unit. The control apparatus is
12 operatively associated with the first attaching apparatus and with the second attaching
13 apparatus to produce at least two conditions. In a first of the conditions, the second bone
14 unit is urged in a first direction relative to the first bone unit for one of the distraction and
15 the compression of the at least one of the bones and/or providing controlled rotation of the
16 joint. In a second of the conditions, the second bone unit is urged in a direction other than
17 the first direction for the distraction and the compression of the at least one of the bones
18 and/or joint. The control apparatus can also provide for control of relative rotation of the
19 joint. The control apparatus preferably includes a reformably deformable member that
20 positions the first attaching apparatus and the second attaching apparatus in juxtaposed
21 orientation relative to each other.

22 The novel features considered characteristic of the embodiments of the present
23 invention are set forth in the appended claims. The embodiments of the present invention
24 themselves, however, both as to their construction and their method of operation together
25 with additional objects and advantages thereof will be best understood from the following

- 1 description of the specific embodiments when read and understood in connection with the
- 2 accompanying drawing.

1 **3. Brief description of the drawing.**

2 The figures of the drawing are briefly described as follows:

3 **FIGURE 1** is a diagrammatic side elevational view of the prior art distraction
4 apparatus taught by United States Patent Number 5,074,865 to
5 Fahmy;

6 **FIGURE 2** is a diagrammatic elevational view of the orthopedic external fixator
7 of the embodiments of the present invention;

8 **FIGURE 3** is a diagrammatic top plan view taken generally in the direction of
9 **ARROW 3** in **FIGURE 2**; and

10 **FIGURES 4A-4D** are a flowchart of the method for using an orthopedic apparatus for
11 bridging between a first bone unit and a second bone unit.

- 1 **4. List of reference numerals utilized in the drawing.**
- 2 **A Prior art.**
- 3 **10** distraction apparatus for maintaining fractured joint **12** during healing
- 4 **12** fractured joint
- 5 **14** pair of pins for insertion into bone **16** at positions proximal to **18** and distal to **20**
- 6 fractured joint **12**
- 7 **16** bone
- 8 **18** position proximal to fractured joint **12**
- 9 **20** position distal to fractured joint **12**
- 10 **22** pair of stainless steel wire springs
- 11 **24** pin insertions into bone **16**
- 12 **B. General.**
- 13 **30** orthopedic apparatus of embodiments of present invention for bridging between
- 14 first bone unit **32** and second bone unit **34** of at least one of injured bone **36** and
- 15 injured joint **38** for one of distraction (direction of **ARROWS 40**), compression
- 16 (direction of **ARROWS 42**), static positioning and/or control range or rotational
- 17 motion of at least one of the bones **36** and/or joint **38**
- 18 **32** first bone unit
- 19 **34** second bone unit
- 20 **36** injured bone
- 21 **38** injured joint
- 22 **40** direction of **ARROWS** of distraction
- 23 **42** direction of **ARROWS** of compression

24 **C. Overall configuration of orthopedic apparatus 30.**

25 **44** first attaching apparatus for connecting apparatus 30 to first bone unit 32

26 **46** second attaching apparatus for connecting apparatus 30 to second bone unit 34

27 **48** control apparatus

28 **50** reformably deformable member of control apparatus 48 that moves first attaching
29 apparatus 44 and second attaching apparatus 46 relative to each other

30 **D. Specific configuration of first attaching apparatus 44.**

31 **52** at least one first generally circular-shaped ring of first attaching apparatus 44 for
32 receiving end 54 of at least one first pin 56, respectively, passing transversely at
33 least into first bone unit 32

34 **54** end of at least one first pin 56 passing transversely at least into first bone unit 32

35 **56** at least one first pin passing transversely at least into first bone unit 32

36 **58** direction of **ARROWS** of flexion and extension

37 **62** center of rotation of head 64 of first bone unit 32

38 **64** head of first bone unit 32

39 **E. Specific configuration of second attaching apparatus 46.**

40 **66** at least one second generally circular-shaped ring of second attaching apparatus 46
41 for receiving end 68 of at least one second pin 70, respectively, passing
42 transversely at least into second bone unit 34

43 **68** end of at least one second pin 70 passing transversely at least into second bone unit
44 34

- 1 **70** at least one second pin passing transversely at least into second bone unit **34**
- 2 **78** rod of at least a pair of second generally circular-shaped rings **66** of second
- 3 attaching apparatus **46**
- 4 **80** one side of at least one of injured bone **36** and injured joint **38**
- 5 **82** other side of at least one of injured bone **36** and injured joint **38**
- 6 **84** other end of at least one first pin **56**
- 7 **86** other end of at least one second pin **76**
- 8 **F. Specific configuration of control apparatus 48.**
- 9 **88** generally rhombus-shaped ring of control apparatus **48**
- 10 **90** forward angle of generally rhombus-shaped ring **88** of control apparatus **48**
- 11 **92** rearward angle of generally rhombus-shaped ring **88** of control apparatus **48**
- 12 **94** top angle of generally rhombus-shaped ring **88** of control apparatus **48**
- 13 **96** bottom angle of generally rhombus-shaped ring **88** of control apparatus **48**

1 **5. Detailed description of the preferred embodiments.**

2 **A. General.**

3 Referring now to the figures, in which like numerals indicate like parts, and more
4 particularly to **FIGURES 2 and 3**, which are, respectively, a diagrammatic elevational
5 view of the external fixator of the embodiments of the present invention, and a
6 diagrammatic top plan view taken generally in the direction of **ARROW 3** in **FIGURE 2**,
7 the orthopedic apparatus of the embodiments of the present invention is shown generally at
8 **30** for bridging between a first bone unit **32** and a second bone unit **34** of at least one being
9 an injured bone **36** and/or an injured joint **38** for one of distraction (direction of **ARROWS**
10 **40**), compression (direction of **ARROWS 42**), static position, and control of range of
11 relative rotary motion of the at least one of the bones **36** and the joint **38**.

12 **B. The overall configuration of the orthopedic apparatus 30.**

13 The orthopedic apparatus **30** comprises a first attaching apparatus **44**, a second attaching
14 apparatus **46**, and a control apparatus **48**. The first attaching apparatus **44** is for connecting
15 the apparatus **30** to the first bone unit **32**. The second attaching apparatus **46** is for
16 connecting the apparatus **30** to the second bone unit **34**. The control apparatus **48** is
17 operatively associated with the first attaching apparatus **44** and with the second attaching
18 apparatus **46** to produce at least two conditions. In a first of the conditions, the second
19 bone unit **34** is urged in a first direction relative to the first bone unit **32** for one of the
20 distraction (**ARROWS 40**) and the compression (**ARROWS 42**) of the at least one of the
21 injured bone **36** and the injured joint **38**. In a second of the conditions, the second bone
22 unit **34** is translated and/or rotated in a direction other than the first direction for the other
23 one of the distraction (**ARROWS 40**) and the compression (**ARROWS 42**) of the at least

1 one of the injured bone 36 and/or the injured joint 38. The control apparatus 48 includes a
2 reformably deformable member 50 that moves the first attaching apparatus 44 and the
3 second attaching apparatus 46 relative to each other.

4 The apparatus 30 is made from a material selected from the group consisting of
5 stainless steel, aluminum, and brass.

6 **C. The specific configuration of the first attaching apparatus 44.**

7 The first attaching apparatus 44 includes at least one first generally circular-shaped ring
8 52. The at least one first generally circular-shaped ring 52 of the first attaching apparatus
9 44 is for receiving an end 54 of at least one first pin 56, respectively, passing transversely
10 at least into the first bone unit 32.

11 The at least one first pin 56 is selected from the group consisting of a K-wire and a
12 rod, each having a diameter in a range of 0.045 - 0.062 inches.

13 The at least one first pin 56 is for passing transversely at least into the center of
14 rotation 62 of the head 64 of the first bone unit 32 so as to allow the second bone unit 34 to
15 rotate by flexion and extension (direction of ARROWS 58) by allowing the apparatus 30
16 to pivot around the at least one first pin 56 when the at least one first pin 56 is one first pin
17 56.

18 **D. The specific configuration of the second attaching apparatus 46.**

19 The second attaching apparatus 46 includes at least one second generally circular-shaped
20 ring 66. The at least one second generally circular-shaped ring 66 of the second attaching
21 apparatus 46 is for receiving an end 68 of at least one second pin 70, respectively, passing
22 transversely at least into the second bone unit 34.

1 The at least one second pin **70** is selected from the group consisting of a K-wire
2 and a rod, each having a diameter in a range of 0.045 - 0.062 inches.

3 The at least one second generally circular-shaped ring **66** of the second attaching
4 apparatus **46** is at least a pair of second generally circular-shaped rings **66**. The at least
5 one pair of second generally circular-shaped rings **66** of the second attaching apparatus **46**
6 receives at least a pair of second pins **70**, respectively.

7 The at least one pair of second generally circular-shaped rings **66** of the second
8 attaching apparatus **46** are connected to each other by a rod **78**.

9 As shown in **FIGURE 3**, the apparatus **30** is for positioning on one side **80** of the
10 at least one of the injured bone **36** and the injured joint **38**. Another apparatus **30** is for
11 positioning on the other side **82** of the at least one of the injured bone **36** and the injured
12 joint **38** and receives the other end **84** of the at least one first pin **56**, respectively, and the
13 other end **86** of the at least one second pin **70**, respectively.

14 **E. The specific configuration of the control apparatus 48.**

15 The control apparatus **48** includes a generally rhombus-shaped ring **88**. The generally
16 rhombus-shaped ring **88** of the control apparatus **48** is straddled by the at least one first
17 generally circular-shaped ring **52** of the first attaching apparatus **44** and the at least one
18 second generally circular-shaped ring **66** of the second attaching apparatus **46**.

19 The generally rhombus-shaped ring **88** of the control apparatus **48** has a forward
20 angle **90** and a rearward angle **92**. The at least one second generally circular-shaped ring
21 **66** of the second attaching apparatus **46** extends forwardly from the forward angle **90** of
22 the generally rhombus-shaped ring **88** of the control apparatus **48**. The at least one first
23 generally circular-shaped ring **52** of the first attaching apparatus **44** extends rearwardly

1 from the rearward angle 92 of the generally rhombus-shaped ring 88 of the control
2 apparatus 48.

3 The generally rhombus-shaped ring 88 of the control apparatus 48 has a top angle
4 94 and a bottom angle 96. The top angle 94 of the generally rhombus-shaped ring 88 of
5 the control apparatus 48 and the bottom angle 96 of the generally rhombus-shaped ring 88
6 of the control apparatus 48 when moved cause the generally rhombus-shaped ring 88 of the
7 control apparatus 48 to deform and move the first attaching apparatus 44 and the second
8 attaching apparatus 46 relative to each other, and in doing so, moves the first bone unit 32
9 and the second bone unit 34 relative to each other.

10 The generally rhombus-shaped ring 88 of the control apparatus 48 is made from a
11 non-memory metal so as to allow it to maintain its deformed shape once deformed, and is
12 deformed to move the first attaching apparatus 44 and the second attaching apparatus 46
13 relative to each other in a range of 1 - 3 mm.

14 **F. The method for using the orthopedic apparatus 30 for bridging between the**
15 **first bone unit 32 and the second bone unit 34 of the at least one of the injured**
16 **bone 36 and the injured joint 38 for one of the distraction, the compression,**
17 **the static positioning and/or control of range of relative rotary motion of the at**
18 **least one of the bones 36 and/or the joint 38.**

19 The method for using the orthopedic apparatus 30 for bridging between the first bone unit
20 32 and the second bone unit 34 of the at least one of the bones 36 and/or the joint 38 for
21 one of the distraction, the compression, the static positioning and/or control of range of
22 relative motion of the at least one of the bones 36 and/or the joint 38 can best be seen in
23 **FIGURES 4A-4ZZ**, which are a flowchart of the method for using an orthopedic
24 apparatus for bridging between a first bone unit and a second bone unit, and as such, will
25 be discussed with reference thereto.

26 The method for using the orthopedic apparatus **30** for bridging between the first
27 bone unit **32** and the second bone unit **34** of the at least one of the bones **36** and/or the joint
28 **38** for one of the distraction, the compression, the static positioning and/or the control of
29 range or relative motion of the at least one of the bones **36** and the joint **38** comprises the
30 steps of:

31 **STEP 1:** Inserting the at least one first pin **56** transversely at least into the first bone
32 unit **32**, leaving the end **54** of the at least one first pin **56** sticking out from
33 the first bone unit **32** on the one side **80** of the at least one of the bones **36**
34 and/or the joint **38**.

35 **STEP 2:** Inserting the at least one second pin **70** transversely at least into the second
36 bone unit **34**, leaving the end **68** of the at least one second pin **70** sticking
37 out from the second bone unit **34** on the one side **80** of at the least one of
38 the bones **36** and the joint **38**.

39 **STEP 3:** Positioning the apparatus **30** on the one side **80** of the at least one of the
40 bones **36** and the joint **38**.

41 **STEP 4:** Sliding the first attaching apparatus **44** over the end **54** of the at least one
42 first pin **56** so as to allow the first attaching apparatus **44** to pivot relative to
43 the at least one first pin **56** when the at least one first pin **56** is one first pin
44 **56**, and sliding the second attaching apparatus **46** over the end **68** of the at
45 least one second pin **70**, respectively, and in doing so, mounting the
46 apparatus **30** to the at least one first pin **56** and to the at least one second pin
47 **70**.

1 **STEP 5:** Crimping the end **54** of the at least one first pin **56** and crimping the end **68**
2 of the at least one second pin **70**, and in so doing, affixing the apparatus **30**
3 to the at least one first pin **56** and to the at least one second pin **70**.

4 **STEP 6:** Deforming the control apparatus **48** to produce at least two conditions. In a
5 first of the conditions, the second bone unit **34** is urged in a first direction
6 relative to the first bone unit **32** for one of the distraction, the compression,
7 the static positioning and/or the control of range or relative rotary motion of
8 the at least one of the bones **36** and/or the joint **38**. In a second of the
9 conditions, the second bone unit **34** is urged in a direction other than the
10 first direction for the other one of the distraction, the compression, the static
11 positioning and/or the control of range or relative rotary motion of the at
12 least one of the bones **36** and the joint **38**.

13 **G. The impressions.**

14 It will be understood that each of the elements described above or two or more together
15 may also find a useful application in other types of constructions differing from the types
16 described above.

17 While the embodiments of the present invention have been illustrated and
18 described as embodied in a orthopedic external fixator and method of use, however, they
19 are not limited to the details shown, since it will be understood that various omissions,
20 modifications, substitutions, and changes in the forms and details of the embodiments of
21 the present invention illustrated and their operation can be made by those skilled in the art
22 without departing in any way from the spirit of the embodiments of the present invention.

1 Without further analysis the foregoing will so fully reveal the gist of the
2 embodiments of the present invention that others can by applying current knowledge
3 readily adapt them for various applications without omitting features that from the
4 standpoint of prior art fairly constitute characteristics of the generic or specific aspects of
5 the embodiments of the present invention.

6. Claims.

The invention claimed is:

- 1 1. An orthopedic apparatus for bridging between a first bone unit and a second bone
2 unit, the apparatus comprising:
- 3 a) first attaching means for connecting said apparatus to the first bone unit;
- 4 b) second attaching means for connecting said apparatus to the second bone
5 unit; and
- 6 c) control means operatively associated with said first attaching means and
7 with said second attaching means to produce at least two conditions:
- 8 i) in a first of said conditions, the second bone unit is urged in a first
9 direction relative to the first bone unit, and
- 10 ii) in a second of said conditions, the second bone unit is urged in a
11 direction other than said first direction;
- 12 wherein said control means includes a reformably deformable member which urges
13 said first attaching means and said second attaching means relative to each other.
- 1 2. The apparatus of claim 1, wherein said apparatus is made from a material selected
2 from the group consisting of stainless steel, aluminum, and brass.
- 1 3. The apparatus of claim 1, wherein said first attaching means includes at least one
2 first generally circular-shaped ring; and

3 wherein said at least one first generally circular-shaped ring of said first attaching
4 means is for receiving an end of at least one first pin, respectively, passing
5 transversely at least into the first bone unit.

1 4. The apparatus of claim 3, wherein said at least one first pin is selected from the
2 group consisting of a K-wire and a rod.

1 5. The apparatus of claim 4, wherein said at least one first pin is a K-wire having a
2 diameter in a range of 0.045 - 0.062 inches.

1 6. The apparatus of claim 3, wherein said at least one first pin is for passing
2 transversely at least into the center of rotation of the head of the first bone unit so
3 as to allow the second bone unit to rotate by flexion and extension by allowing said
4 apparatus to pivot around said at least one first pin.

1 7. The apparatus of claim 3, wherein said second attaching means includes at least
2 one second generally circular-shaped ring; and
3 wherein said at least one second generally circular-shaped ring of said second
4 attaching means receives an end of at least one second pin, respectively, passing
5 transversely at least into the second bone unit.

1 8. The apparatus of claim 7, wherein said at least one second pin is selected from the
2 group consisting of a K-wire and a rod.

- 1 9. The apparatus of claim 8, wherein said at least one second pin is a K-wire having a
2 diameter in a range of 0.045 - 0.062 inches.
- 1 10. The apparatus of claim 7, wherein said at least one second generally circular-
2 shaped ring of said second attaching means is at least a pair of second generally
3 circular-shaped rings; and
4 wherein said at least a pair of second generally circular-shaped rings of said second
5 attaching means receive at least a pair of second pins, respectively.
- 1 11. The apparatus of claim 10, wherein said at least a pair of second generally circular-
2 shaped rings of said second attaching means are connected to each other by a rod.
- 1 12. The apparatus of claim 7, wherein said apparatus is for positioning on one side of
2 the at least one of the injured bone and/or injured joint; and
3 wherein another said apparatus is for positioning on the other side of the at least
4 one injured bone and/or injured joint and receives the other end of the at least one
5 first pin, respectively, and the other end of the at least one second pin, respectively.
- 1 13. The apparatus of claim 7, wherein said control means includes a generally
2 rhombus-shaped ring; and

3 wherein said generally rhombus-shaped ring of said control means is straddled by
4 said at least one first generally circular-shaped ring of said first attaching means
5 and said at least one second generally circular-shaped ring of said second attaching
6 means.

1 14. The apparatus of claim 13, wherein said generally rhombus-shaped ring of said
2 control means has:

3 a) a forward angle; and

4 b) a rearward angle;

5 wherein said at least one second generally circular-shaped ring of said second
6 attaching means extends forwardly from said forward angle of said generally
7 rhombus-shaped ring of said control means; and

8 wherein said at least one first generally circular-shaped ring of said first attaching
9 means extends rearwardly from said rearward angle of said generally rhombus-
10 shaped ring of said control means.

1 15. The apparatus of claim 13, wherein said generally rhombus-shaped ring of said
2 control means has:

3 a) a top angle; and

4 b) a bottom angle;

5 wherein said top angle of said generally rhombus-shaped ring of said control means
6 and said bottom angle of said generally rhombus-shaped ring of said control means
7 when moved cause said generally rhombus-shaped ring of said control means to

8 deform and move said first attaching means and said second attaching means
9 relative to each other, and in doing so, moves the first bone unit and the second
10 bone unit relative to each other.

1 16. The apparatus of claim 15, wherein said generally rhombus-shaped ring of said
2 control means is made from a non-memory metal so as to allow it to maintain its
3 deformed shape once deformed.

1 17. The apparatus of claim 15, wherein said generally rhombus-shaped ring of said
2 control means is deformed to move said first attaching means and said second
3 attaching means relative to each other in a range of 1 - 3 mm.

1 18. A method for using an orthopedic apparatus for bridging between a first bone unit
2 and a second bone unit of at least one of the bones and/or joint for one of
3 distraction, compression, static position and/or control of range of rotary motion of
4 the at least one of the bones and/or the joint, the method comprising the steps of:

5 a) inserting at least one first pin transversely at least into the first bone unit,
6 leaving an end of the at least one first pin sticking out from the first bone
7 unit on one side of the at least one of the bones and/or the joint;

8 b) inserting at least one second pin transversely at least into the second bone
9 unit, leaving an end of the at least one second pin sticking out from the
10 second bone unit on the one side of the at least one of the bones and/or the
11 joint;

- 12 c) positioning the apparatus on the one side of the at least one of the bones
13 and/or the joint;
- 14 d) sliding first attaching means of the apparatus over the end of the at least one
15 first pin so as to allow the first attaching means to pivot relative to the at
16 least one first pin when the at least one first pin is one pin, and sliding
17 second attaching means of the apparatus over the end of the at least one
18 second pin, respectively, and in doing so, mounting the apparatus to the at
19 least one first pin and to the at least one second pin; and
- 20 e) deforming control means of the apparatus to produce at least two
21 conditions:
- 22 i) in a first of the conditions, the second bone unit is urged in a first
23 direction relative to the first bone unit for one of the distraction, the
24 compression, the static position, and/or the control of range of rotary
25 motion of the at least one of the bones and/or the joint, and
- 26 ii) in a second of the conditions, the second bone unit is urged in a
27 direction other than the first direction for the other one of the
28 distraction, the compression, the static positioning, and/or the
29 control of range or rotary motion of the at least one of the bones
30 and/or the joint.

- 1 19. The method of claim 18, further comprising the step of crimping the end of the at
2 least one first pin and crimping the end of the at least one second pin, and in so
3 doing, affixing the apparatus to the at least one first pin and to the at least one
4 second pin.

- 1 20. The method of claim 18, wherein said positioning step includes positioning the
2 apparatus that is made from a material selected from the group consisting of
3 stainless steel, aluminum, and brass, on the one side of the at least one of the bones
4 and/or the injured joint.
- 1 21. The method of claim 18, wherein said sliding step includes sliding first attaching
2 means of the apparatus that is at least one first generally circular-shaped ring over
3 the end of the at least one first pin, respectively, so as to allow the first attaching
4 means to pivot relative to the at least one first pin when the at least one first pin is
5 one first pin, and sliding the second attaching means of the apparatus over the end
6 of the at least one second pin, respectively.
- 1 22. The method of claim 18, wherein said first inserting step includes inserting at least
2 one first pin that is selected from the group consisting of a K-wire and a rod
3 transversely at least into the first bone unit, leaving an end of the at least one first
4 pin sticking out from the first bone unit on one side of the at least one of the bones
5 and/or the joint.
- 1 23. The method of claim 18, wherein said inserting step includes inserting at least one
2 first pin that is selected from the group consisting of a K-wire and a rod, each with
3 a diameter in a range of 0.045 - 0.062 inches, transversely at least into the first
4 bone unit, leaving an end of the at least one first pin sticking out from the first bone
5 unit on one side of the at least one of the bones and/or the joint.

1 24. The method of claim 18, wherein said first inserting step includes inserting at least
2 one first pin through the center of rotation of the head of the first bone unit, leaving
3 an end of the at least one first pin sticking out from the first bone unit on one side
4 of the at least one of the bones and/or the joint so as to allow the second bone unit
5 to rotate by flexion and extension by allowing the apparatus to pivot around the at
6 least one first pin when the at least one first pin is one first pin.

1 25. The method of claim 21, wherein said sliding step includes sliding first attaching
2 means of the apparatus over the end of the at least one first pin so as to allow the
3 first attaching means to pivot relative to the at least one first pin when the at least
4 one first pin is one first pin, and sliding the second attaching means of the
5 apparatus that is at least one second generally circular-shaped ring over the end of
6 the at least one second pin, respectively.

1 26. The method of claim 18, wherein said inserting step includes inserting at least one
2 second pin that is selected from the group consisting of a K-wire and a rod
3 transversely at least into the second bone unit, leaving an end of the at least one
4 second pin sticking out from the second bone unit on the one side of the at least one
5 of the bones and/or the joint.

1 27. The method of claim 18, wherein said inserting step includes inserting at least one
2 second pin that is selected from the group consisting of a K-wire and a rod, each

3 having a diameter in a range of 0.045 - 0.062 inches, transversely at least into the
4 second bone unit, leaving an end of the at least one second pin sticking out from
5 the second bone unit on the one side of the at least one of the bones and/or the
6 joint.

1 28. The method of claim 18, wherein said sliding step includes sliding first attaching
2 means of the apparatus that is at least one first generally circular-shaped ring over
3 the end of the at least one first pin, respectively, so as to allow the first attaching
4 means to pivot relative to the at least one first pin when the at least one first pin is
5 one first pin, and sliding the second attaching means of the apparatus that is at least
6 a pair of second generally circular-shaped rings over the end of at least a pair of
7 second pins, respectively.

1 29. The method of claim 18, wherein said sliding step includes sliding first attaching
2 means of the apparatus that is at least one first generally circular-shaped ring over
3 the end of the at least one first pin, respectively, so as to allow the first attaching
4 means to pivot relative to the at least one first pin when the at least one first pin is
5 one first pin, and sliding the second attaching means of the apparatus that is at least
6 a pair of second generally circular-shaped rings connected to each other by a rod
7 over the end of the at least one second pin, respectively.

1 30. The method of claim 18, wherein said positioning step includes positioning the
2 apparatus on the one side of the at least one of the bones and/or the joint and
3 positioning another apparatus on the other side of the at least one of the bones
4 and/or the joint.

1 31. The method of claim 18, wherein said sliding step includes sliding first attaching
2 means of the apparatus over the end of the at least one first pin so as to allow the
3 first attaching means of the apparatus to pivot relative to the at least one first pin
4 when the at least one first pin is one first pin, sliding second attaching means of the
5 apparatus over the end of the at least one second pin, respectively, and in doing so,
6 mounting the apparatus to the at least one first pin and to the at least one second
7 pin, sliding first attaching means of another apparatus over the other end of the at
8 least one first pin, respectively, so as to allow the first attaching means of the
9 another apparatus to pivot relative to the at least one first pin when the at least one
10 first pin is one first pin, and sliding second attaching means of the another
11 apparatus over the other end of the at least one second pin, respectively, and in
12 doing so, mounting the another apparatus to the at least one first pin and to the at
13 least one second pin.

1 32. The method of claim 25, wherein said deforming step includes deforming control
2 means that is a generally rhombus-shaped ring that is straddled by the at least one
3 first generally circular-shaped ring of the first attaching apparatus and the at least
4 one second generally circular-shaped ring of the second attaching means to produce
5 at least two conditions:
6 a) in the first of the conditions, the second bone unit is urged in a first
7 direction relative to the first bone unit for one of the distraction, the
8 compression, the static positioning, and/or the control of range or rotary
9 motion of the at least one of the bones and the joint, and,

10 b) in the second of the conditions, the second bone unit is urged in a direction
11 other than the first direction for the other one of the distraction, the
12 compression, the static positioning, the control of range of rotary motion of
13 the at least one of the bones and/or the joint.

1 33. The method of claim 25, wherein said deforming step includes deforming control
2 means that is a generally rhombus-shaped ring that has a forward angle and a
3 rearward angle.

1 34. The method of claim 33, wherein said deforming step includes deforming control
2 means that is a generally rhombus-shaped ring that has the at least one second
3 generally circular-shaped ring of the second attaching means extending forwardly
4 from the forward angle of the generally rhombus-shaped ring of the control means
5 and has the at least one first generally circular-shaped ring of the first attaching
6 means extending rearwardly from the rearward angle of the generally rhombus-
7 shaped ring of the control means.

1 35. The method of claim 18, wherein said deforming step includes deforming control
2 means that is a generally rhombus-shaped ring that has a top angle and a bottom
3 angle that is moved relative to each other to cause the generally rhombus-shaped
4 ring of the control means to deform and move the first attaching means and the
5 second attaching means relative to each other, and in doing so, moving the first
6 bone unit and the second bone unit relative to each other.

- 1 36. The method of claim 18, wherein said deforming step includes deforming control
2 means that is a generally rhombus-shaped ring made from a non-memory metal so
3 as to allow it to maintain its deformed shape once deformed.
- 1 37. The method of claim 18, wherein said deforming step includes deforming control
2 means that is a generally rhombus-shaped ring that is deformed to move the first
3 attaching means and the second attaching means relative to each other in a range of
4 1 - 3 mm.

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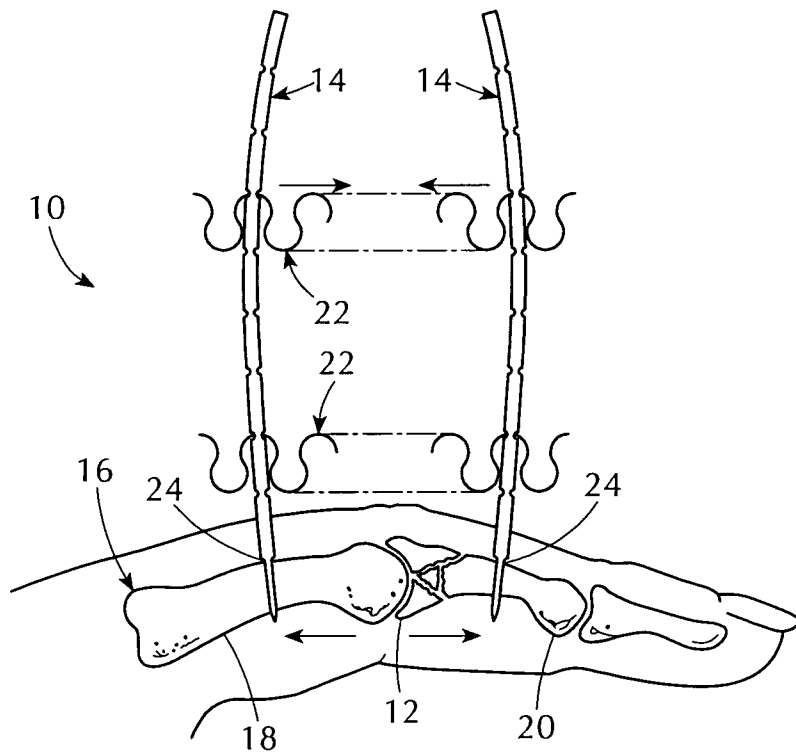


FIG. 1
PRIOR ART

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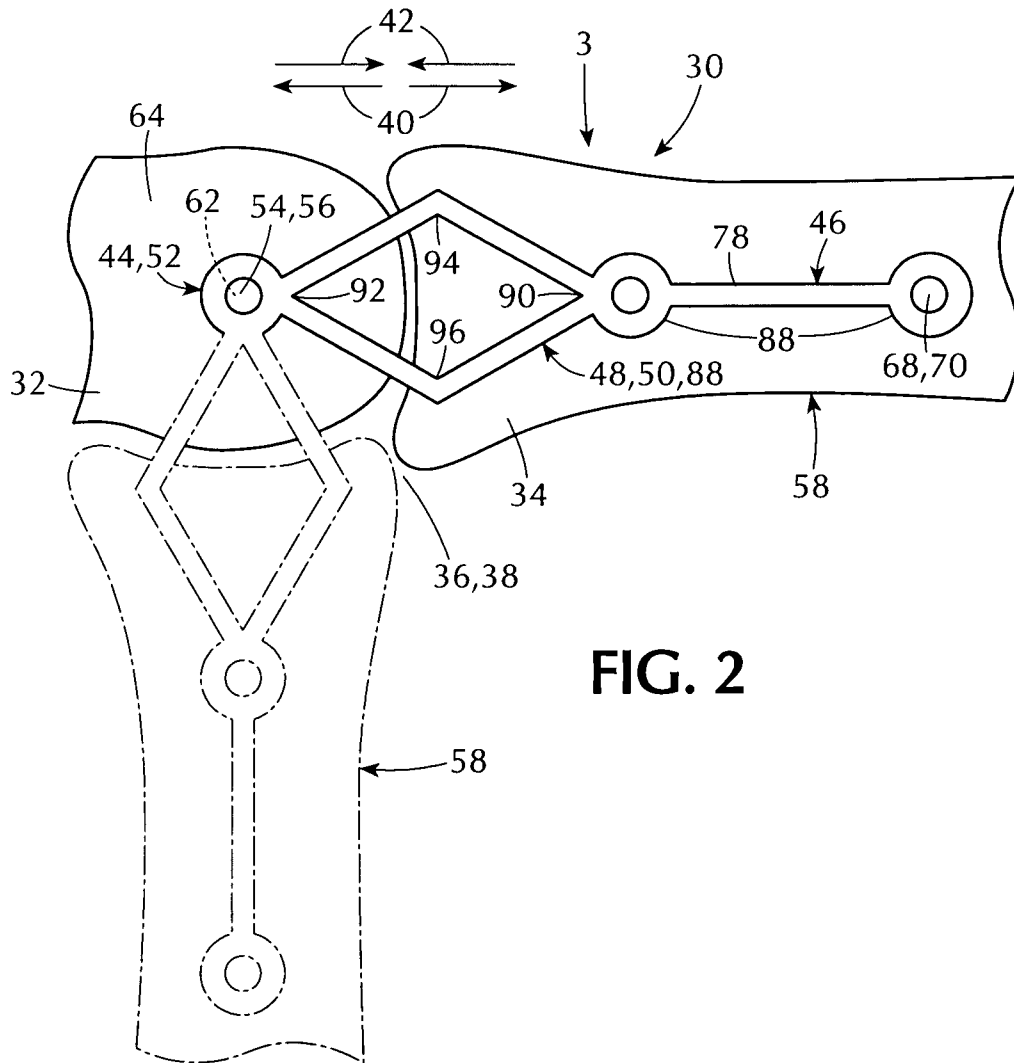
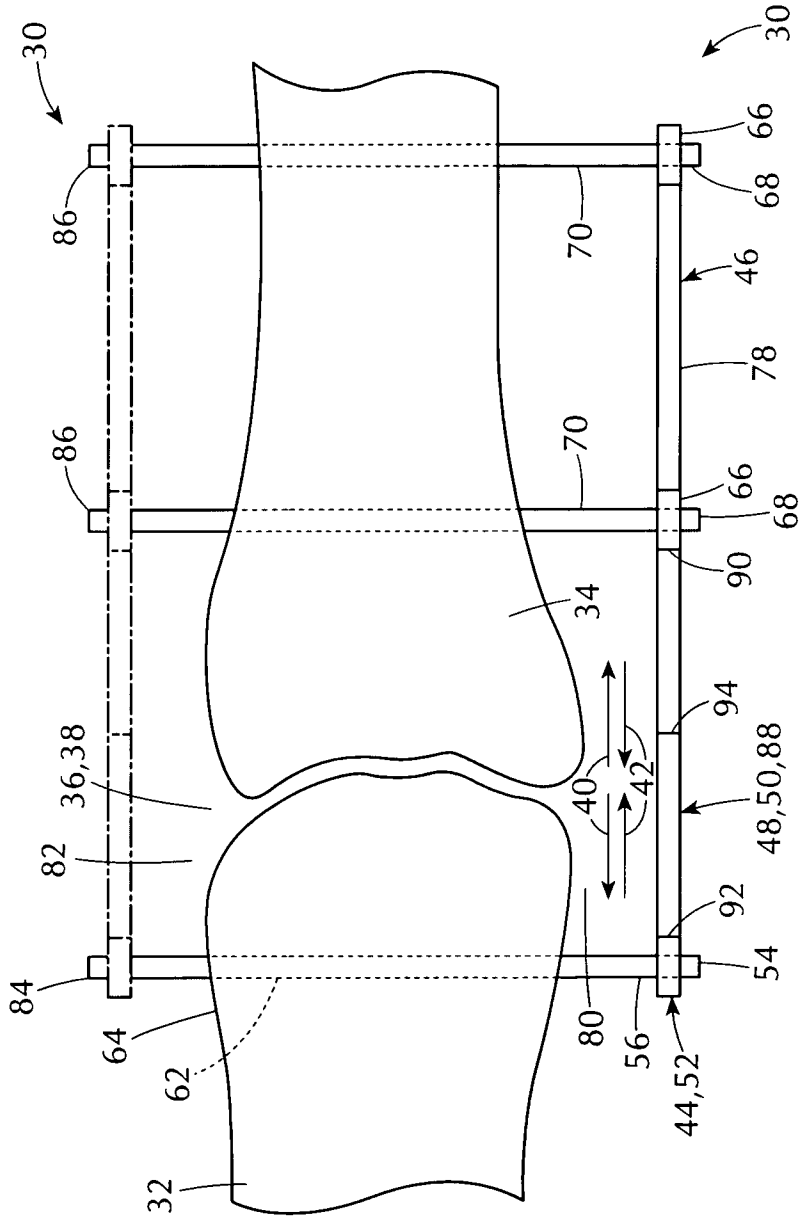


FIG. 2





FIG. 3



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METHOD FOR USING AN ORTHOPEDIC APPARATUS (30) FOR BRIDGING BETWEEN A FIRST BONE UNIT (32) AND A SECOND BONE UNIT (34) OF THE AT LEAST ONE OF THE BONES (36) AND/OR THE JOINT (38) FOR ONE OF DISTRACTION, COMPRESSION, STATIC POSITIONING, AND/OR CONTROL RANGE OF RELATIVE ROTARY MOTION OF THE AT LEAST ONE OF THE BONES (36) AND/OR THE JOINT (38)

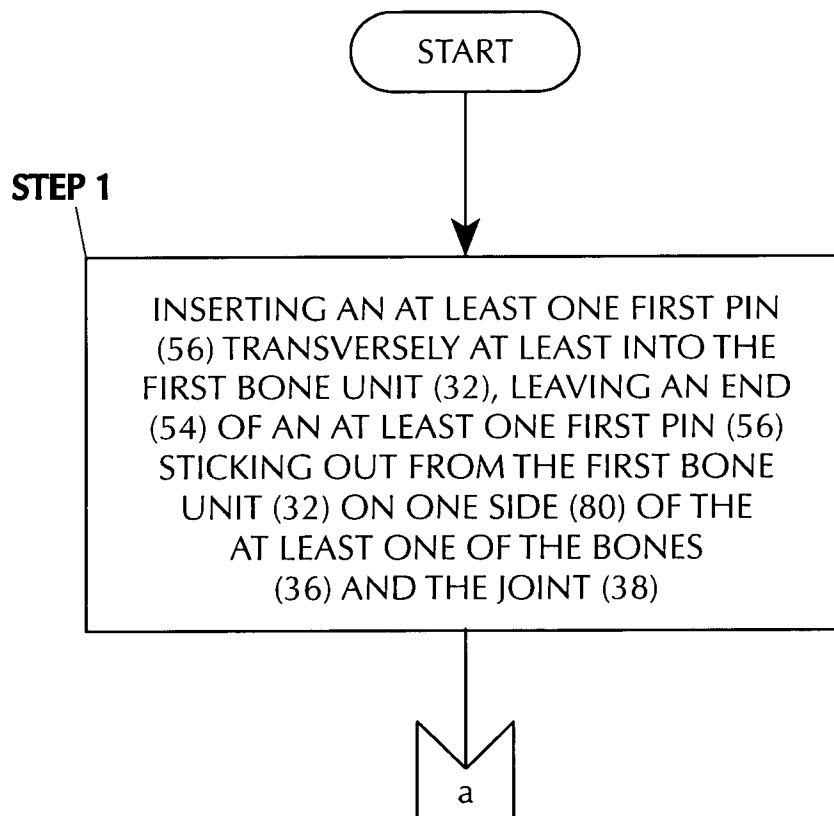


FIG. 4A

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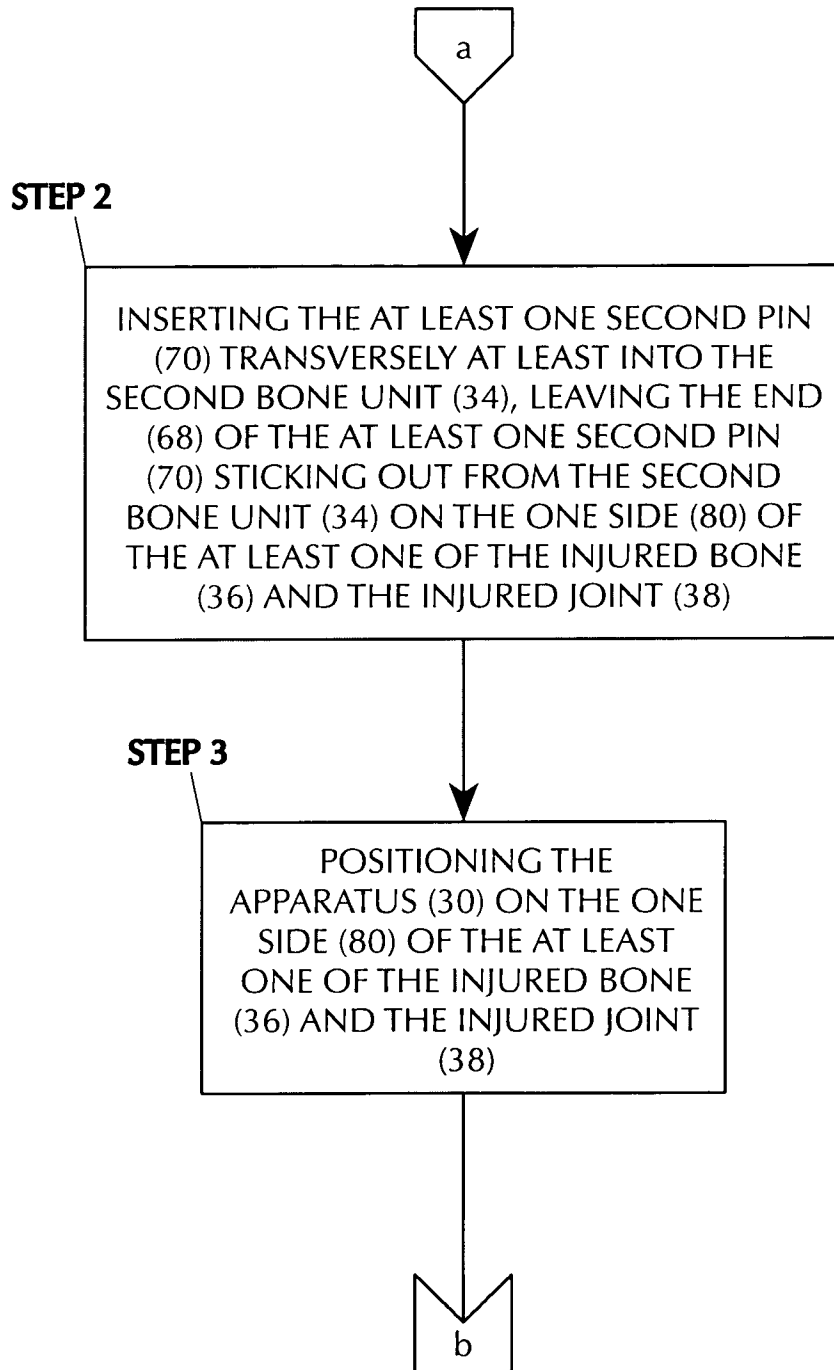


FIG. 4B



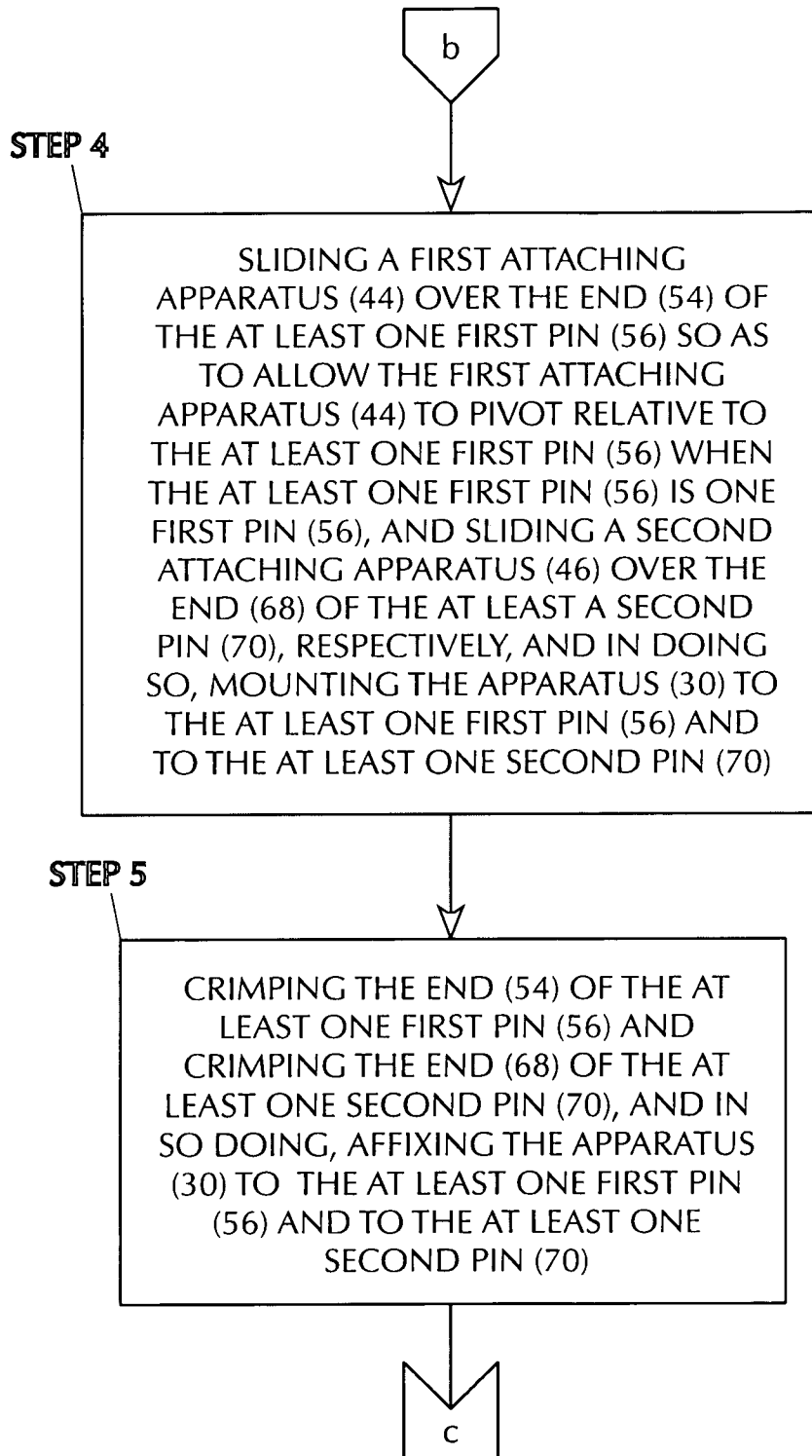


FIG. 4C



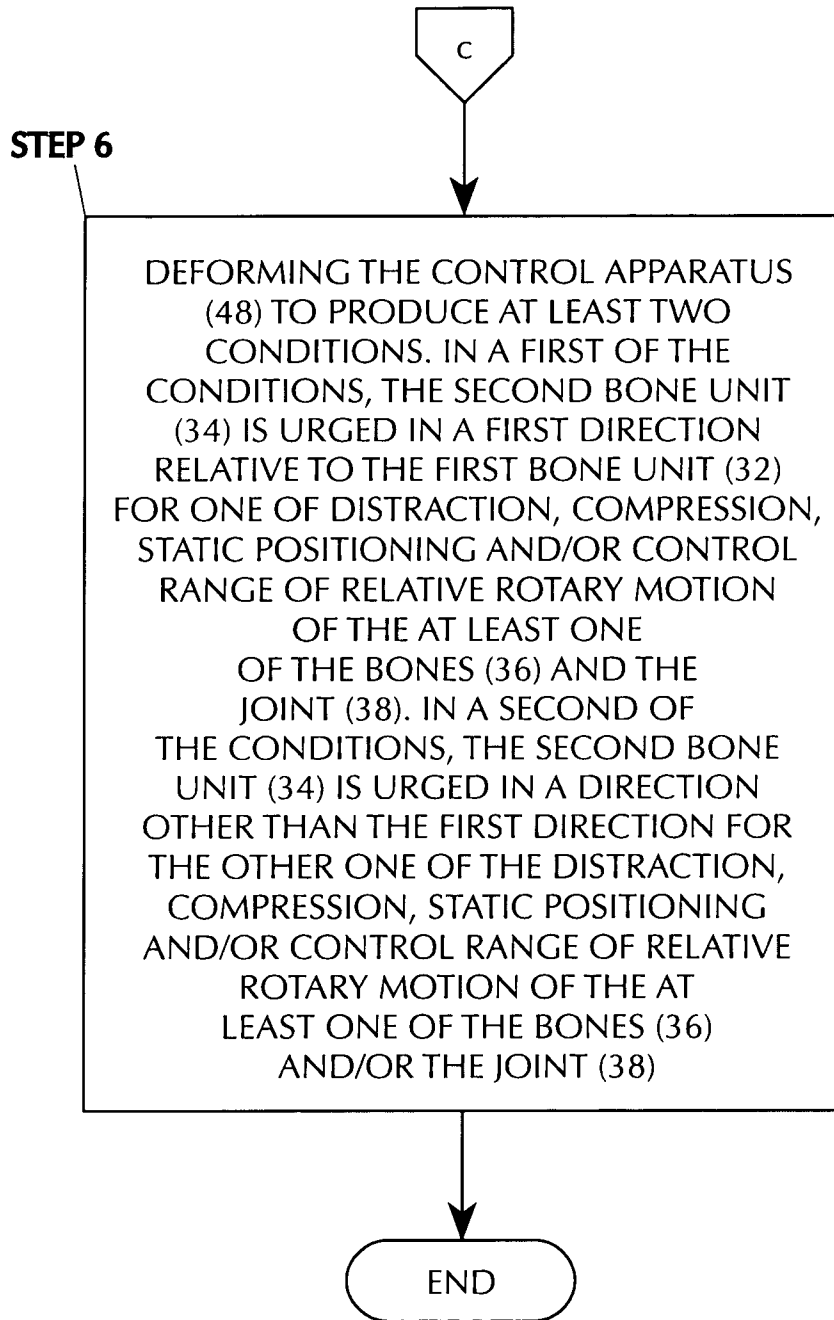


FIG. 4D



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/02143

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(8) - A61B 17/00, A61F 4/00, A61F 5/04 (2010.01)
 USPC - 606/59
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 USPC: 606/59

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 USPC: 606/1, 53, 54, 56, 57, 59 (keyword limited; terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 PUBWEST(PGPB, USPT, EPAB, JPAB); Google
 Search Terms Used: deform\$4, bend\$4, compress\$3, distract\$3, k-wire, kirschner crimp\$, force, rod, member, pin, nail, permanent, fixation, external, screw, bone, shape memory

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 2005/0171539 A1 (BRAUN et al) 04 August 2005 (04.08.2005) fig 2, 25, para [0040]-[0043], [0066], [0069], [0076], [0084]	1-3, 6-7, 10, 13-18, 20-21, 24-25, 28, 30-37 ----- 4-5, 8-9, 11, 12, 19, 22-23, 26-27, 29
Y	US 4,976,712 A (VANDERSLIK) 11 December 1990 (11.12.1990) Abstract, col 1, ln 18-21, col 2, ln 35-46	4-5, 8-9, 12, 19, 22-23, 26-27
Y	US 2002/0115998 A1 SCHOENEFELD) 22 August 2002 (22.08.2002) fig 1, para [0023]	11, 29

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“E” earlier application or patent but published on or after the international filing date	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	“&” document member of the same patent family
“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
 15 September 2010 (15.09.2010)

Date of mailing of the international search report
29 SEP 2010

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