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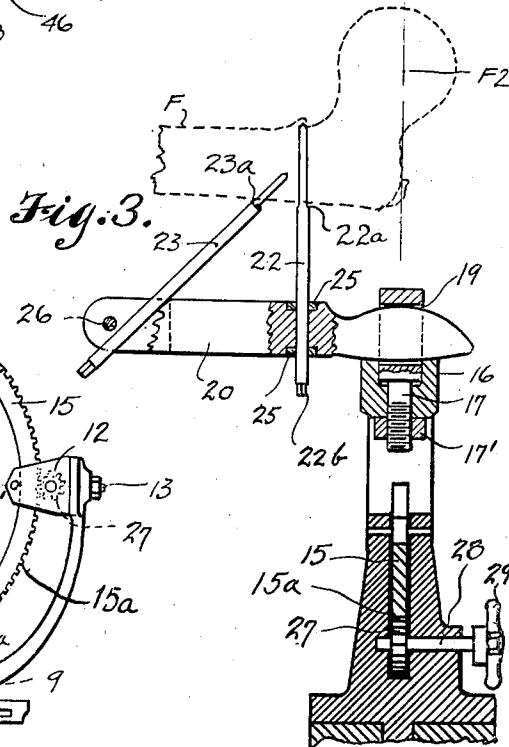
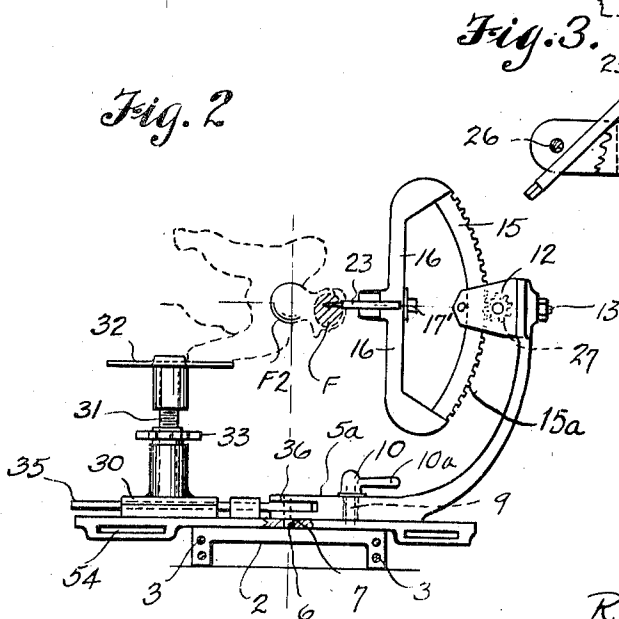
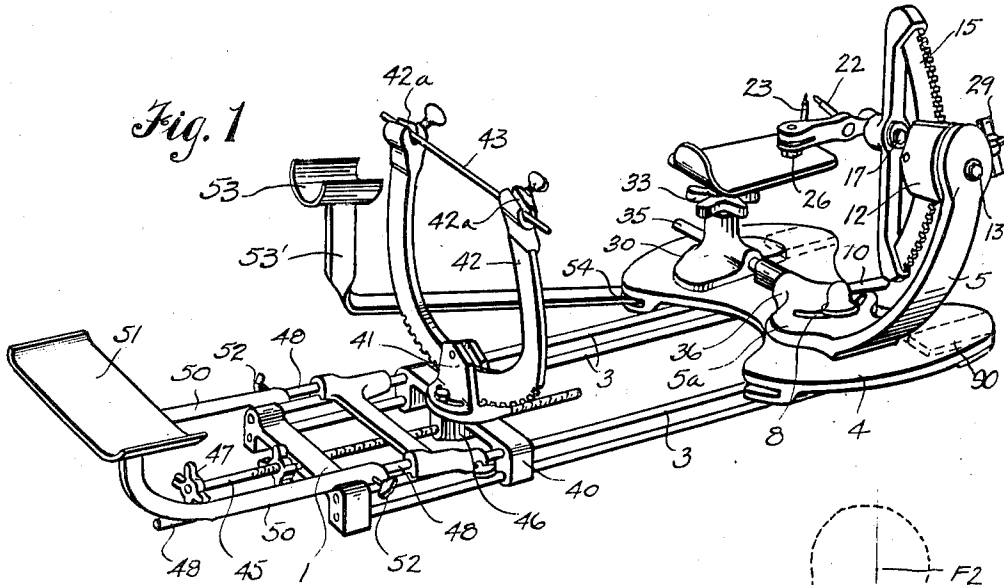
R. ANDERSON

2,185,322

BONE SETTING SPLINT

Filed March 4, 1935

3 Sheets-Sheet 1



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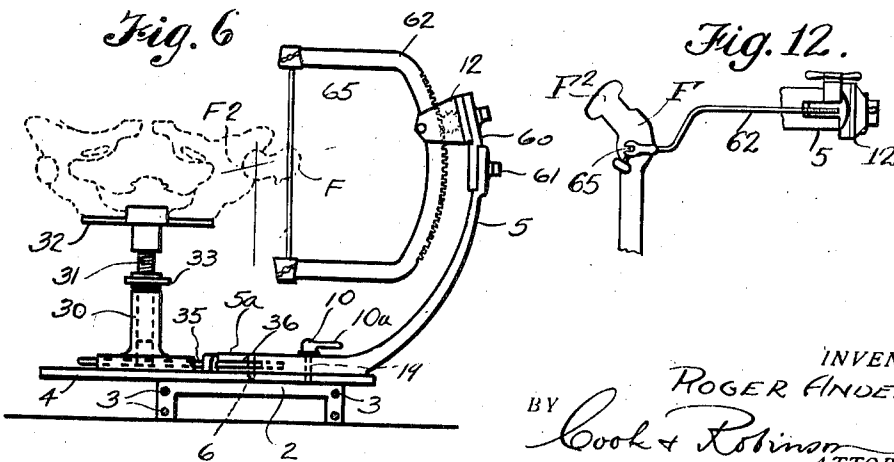
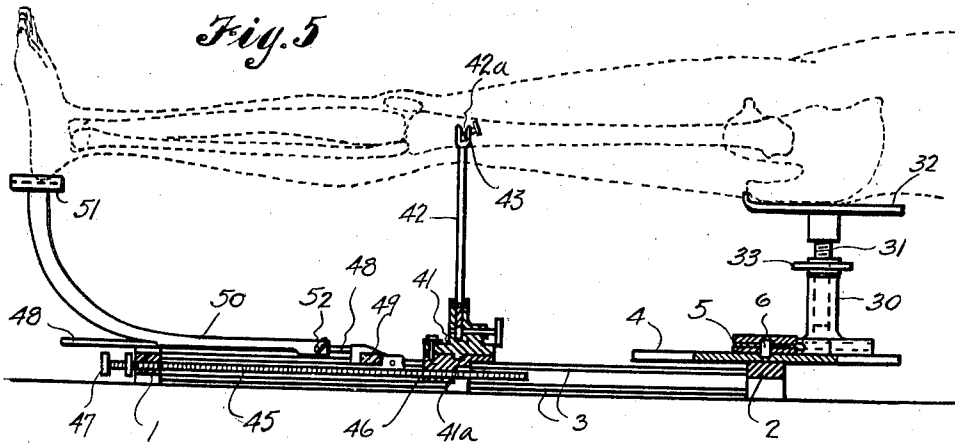
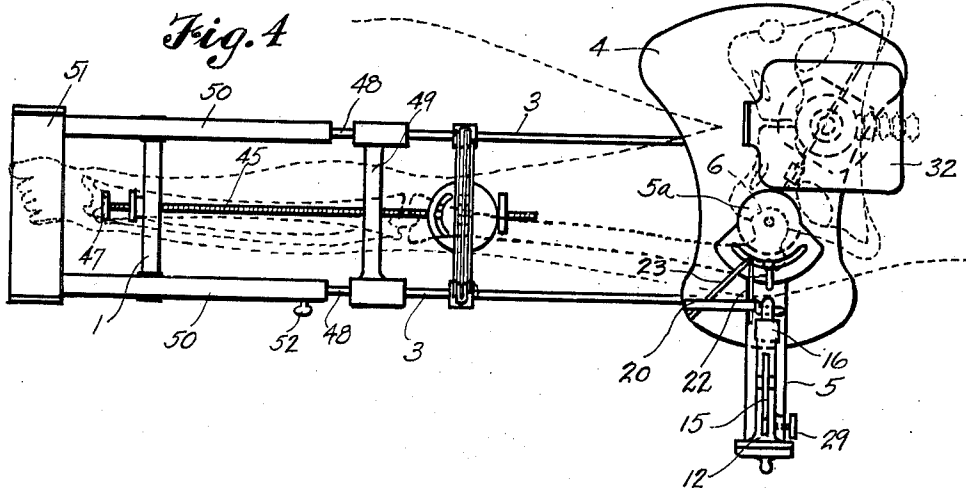
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3 Sheets-Sheet 2



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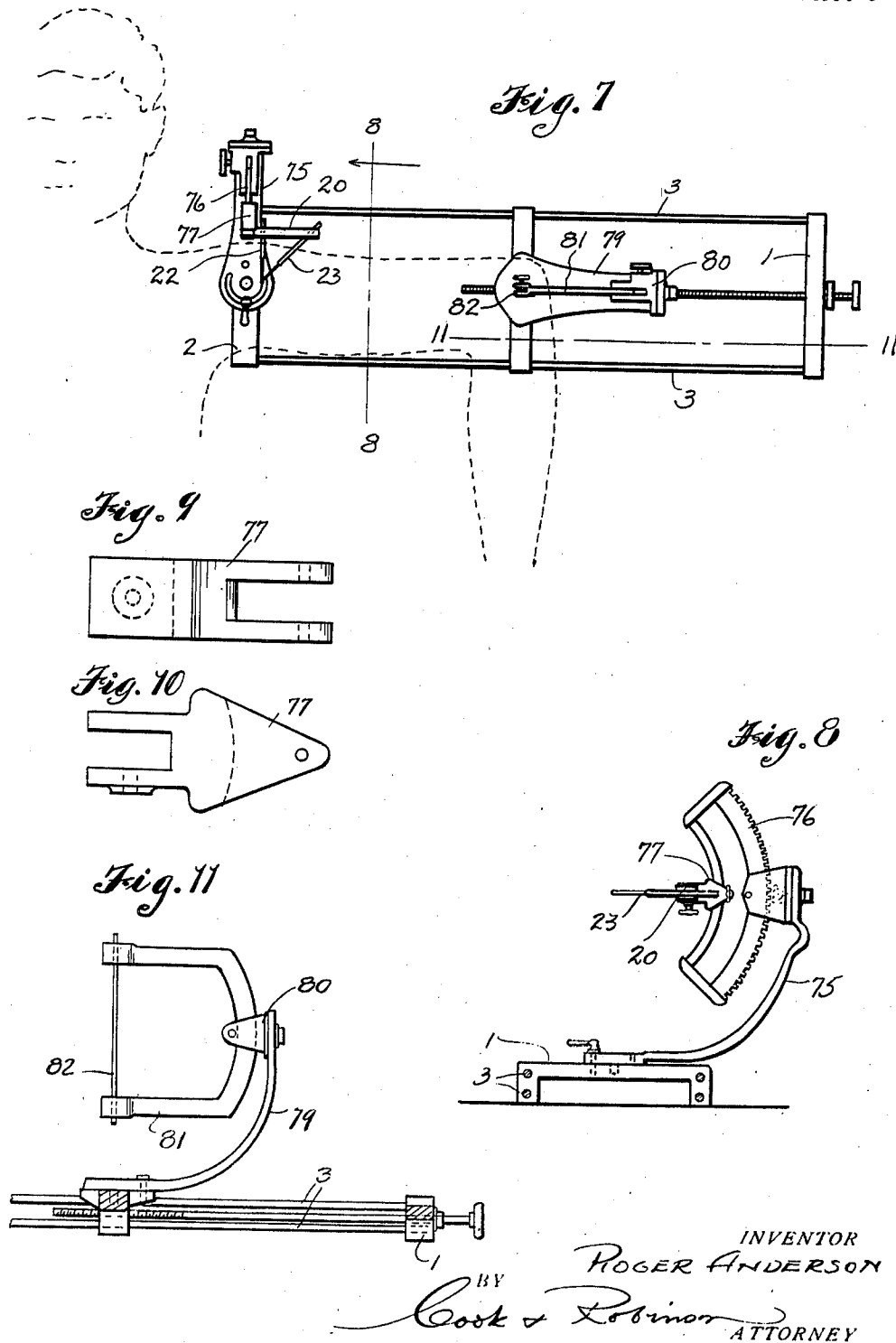
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BONE SETTING SPLINT

Filed March 4, 1935

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,185,322

BONE SETTING SPLINT

Roger Anderson, Seattle, Wash.

Application March 4, 1935, Serial No. 9,191

14 Claims. (Cl. 128—84)

This invention relates to improvements in bone setting splints, and it has reference in particular to splints of a type whereby reduction of the fracture is effected by direct skeletal attachment to the fragments of the fractured bone as distinguished from skin traction, and wherein skeletal countertraction is employed in lieu of the usual gravity countertraction; this being a further development of splints of that kind disclosed in my copending applications filed under Serial Nos. 692,929 and 757,641.

Explanatory to the present invention, it will be here stated that, in the past, fractures of the thigh bone or femur also the upper arm or humerus have been especially difficult to reduce by the ordinary methods, especially if the fracture happened to be close to the upper end of the bone. Furthermore, immobilization methods used in the past have demanded long periods of hospitalization. While the recent advent of improved skeletal traction met many of the difficulties of approximation, it did not lessen the period of recumbency, and, moreover, its too enthusiastic use frequently delayed union, due to the separation of fragments from excessive extension. It has been observed that the effectiveness of skeletal traction is always in direct ratio to the efficiency of its countertraction, and that skeletal countertraction is by far the best form.

In view of the above it has been the principal object of this invention to provide a splint of an improved type comprising specialized forms of skeletal transfixion, for both traction and countertraction through which immediate reduction may be made and which provides for the incorporating of these transfixions in a short cast which will permit of immediate crutch ambulation.

It is also an object of the present invention to provide a special arrangement of half-pins for transfixion of the trochanteric area of the femur which provides positive and direct mechanical control in the manipulation of that fragment.

It is another object of the invention to so construct the splint that the fractured fragments may be rotated relative to each other and by which all rotation is about the normal anatomical axis of the limb.

Still further objects of the invention reside in the modifications of the splint to adapt it to the setting of fractures of the humerus.

Other objects reside in the various details of construction and in the combination of parts and in their mode of operation, especially with respect to adjustability, ease of manipulation, accessibility for application of casts, and for fluoroscopic and X-ray inspection.

In accomplishing the above objects of the invention, I have provided the improved details of construction the preferred forms of which are il-

lustrated in the accompanying drawings, wherein—

Fig. 1 is a perspective view of a bone setting splint embodied by the present invention and designed especially for the reduction of fractures of the femur.

Fig. 2 is a vertical, cross section of the device.

Fig. 3 is an enlarged, detail in horizontal section of the skeletal attachment means for the upper fragment of the broken bone, particularly illustrating the relation of the attachment pins.

Fig. 4 is a top or plan view, of the splint, and an indication of its application.

Fig. 5 is a central, longitudinal section of the splint in a vertical plane.

Fig. 6 is a cross sectional view, illustrating the use of a form of transfixion yoke with the device of Fig. 1 in lieu of the traction pins, as seen in Fig. 3.

Fig. 7 is a plan view of a form of splint designed for the reduction of fractures of the humerus, and an indication of its application.

Fig. 8 is a cross section on line 8—8 in Fig. 7.

Figs. 9 and 10, respectively, are side and top views of the pin mounting bracket as used on the device of Fig. 7.

Fig. 11 is a vertical section on the line 11—11 in Fig. 7.

Fig. 12 is a detail of the yoke arms showing the offsetting of the end portion.

Referring more in detail to the drawings, the present device comprises a rectangular, elongated base frame structure having cross bars 1 and 2 at its opposite ends which are joined at their ends by paired, parallel rods 3—3. Mounted upon one end of this base frame is a horizontal table 4 which extends laterally of the base at its opposite sides, as shown best in Fig. 2, and upon which table is mounted an upwardly and laterally extending bracket, or arm 5. This bracket 5 has a flat and somewhat enlarged base portion 5a resting flatly upon the table 4 and pivotally attached thereto by a pivot stud 6, see Fig. 2, that extends into a socket 7 in the table. Also, there is an arcuate slot 8 in the base 5a concentric of the axial line of the pivot 6, and a bolt 9, that is fixed in the base plate, extends upwardly and through this slot, and has a lock nut 10 threaded thereon which may be tightened by its handle portion 10a, against the base to hold the bracket at any of its different positions of adjustment within the limits provided for by the slot. It will be understood, by reference to Fig. 2, that the bracket 5 is rotatably movable about the vertical axial line of the pivot 6 and also that it may be reversed in its position relative to the splint to accommodate either right or left leg fractures.

Mounted at the upper end of the bracket 5 is a guide block 12 that is attached for rotation about a bolt 13 which secures it to the bracket; that ax-

ial line of rotation of the block being horizontal and intersects the vertical axis of rotation of the bracket 5 at a right angle, as will be apparent by reference to Fig. 2.

5 Mounted in the block 12 is an arcuately curved rack bar 15 adapted to move in the block in a longitudinal direction about its center of curvature which is the point of intersection of the above referred to axes of rotation of the block 12 and
10 of the bracket 5.

The rack bar subtends an arc of approximately one hundred degrees and its opposite ends are connected by a chord 16, and mounted centrally on the chord and radial of the rack bar is a clamp
15 bolt 17 which, as seen in Fig. 3, has an end portion extended beyond the chord and formed with a slot 19 wherein there is mounted the end of a laterally extending bracket 20. Tightening of the bolt 17 by means of a nut 17' that is threaded
20 thereon, causes the bolt to clamp and hold the bracket 20 rigidly with respect to the rack 15.

Mounted by the bracket 20 are the anchor pins
22 and 23 through the mediacy of which a skeletal connection may be made with the upper
25 fragment of the femur in the manner which is illustrated in Figs. 3 and 4, wherein the upper fragment of the femur is designated by reference character F and the ball joint member at F2. In Fig. 3, especially, it is seen that the pin 22 pierces
30 the bone perpendicularly and that it is mounted perpendicularly in the bracket 20, while the pin 23 is disposed at an angle of approximately forty-five degrees with respect to the bracket
35 with its end piercing the bone angularly and close to the end of the pin 22, thus effecting a "toenailed" connection whereby the bone fragment is connected rigidly to bracket 20 and can be manipulated by the mechanical manipulation of the rack for thus overcoming the difficulty of
40 looseness that results from use of a single pin or parallel pins.

It is very important to note in this application of attachment to the bone that the two pins effect
45 their connection at such location in the trochanteric area of the femur that the center of the ball and socket joint, whereby the femur is connected with the pelvic bone, coincides exactly with the center about which the rotative adjustments of the bracket 5 and the rack 15 are made.
50 Thus, when the patient is, properly located, and attachment made at the proper location the manipulation of the fragment F in any manner cannot cause a tendency to displace the joint.

The pin 22 is provided at its end with a portion of reduced diameter and this is pointed for
55 easy piercing of the bone and it has a shoulder 22a for limiting the extent of entrance of the pin into the bone. This pin is rotatably mounted in the bracket 20 but is held against a longitudinal movement therein by means of collars 25 that are
60 fixed on the pin. At its outer end the pin has a squared head 22b to which a wrench or the like may be applied for rotating it. Likewise, the pin 23 has an inner end portion of reduced diameter
65 for easy entrance and is provided with a limiting shoulder 23a. The outer end of the bracket 20 is horizontally slotted to receive the outer end of this pin and the pin is clamped rigidly therein by a clamp bolt 26 extended through that
70 end of the bracket.

To effect an adjustment of the rack bar 15 in a lengthwise direction it is provided with gear teeth
75 15a along its outer edge, and rotatably mounted in the block 12 is a gear pinion 27 operatively meshing with the teeth of the rack. The pinion

is fixed on a shaft 28 that extends from the block and this shaft is equipped with a hand wheel 29 whereby it may be rotated, thus to turn the gear to shift the rack in the block. The block may be rotatably adjusted about its axis upon
loosening the attachment bolt 13.

Observing the device as illustrated in Fig. 2, and assuming that skeletal attachment had been made to the bone in the manner illustrated therein, it is readily apparent that if the block 12 is
10 rotatably adjusted about its axis, the fractured end of the fragment may be tilted upwardly or downwardly while pivoting about the center of the ball and socket joint. It is also apparent that should the rack 15 be adjusted lengthwise,
15 the fragment and the upper thigh will be rotated about the ball and socket joint. This is due to the fact that when the patient is properly located on the table and the skeletal attachment properly made, as seen in Fig. 3, the centers of rotation
20 coincide with the center of the ball and socket joint of the femur.

In use of this splint, the patient is to be partially supported thereby. Therefore, movably
25 mounted upon the table 4 is a supporting standard comprising a base portion 30 in which is mounted a vertically movable post 31. At the upper end of the post is a horizontal plate 32 which serves as a sacral rest, or support for the patient. The post 31 is threaded and has an adjusting wing
30 nut 33 threaded thereon for vertically adjusting the post; the nut seating against the upper end of the base 30. The base 30 is movable along a radial rod 35 which, as shown in Fig. 2, is
35 pivotally attached at its inner end within a recess 36 of the base of the bracket 5 and swings coaxially about the pivot 6. Thus, the sacral rest may be adjusted up or down by manipulation of the nut 33 and also brought toward or moved
40 away from the bracket 5 by sliding it along rod 35, thereby providing for the support of the patient at a proper position for effecting the skeletal attachment, as will later be explained.

At the lower end of the base frame, that being the end opposite that mounting the table 4, is a
45 cross bar 40 that is slidably movable along the longitudinal rods 3—3. Mounted centrally upon the cross bar 40 is a block 41 which is rotatable about a vertical pivot stud 41a, extended therefrom into the cross bar. This block adjustably
50 mounts therein an upwardly opening, U-shaped yoke 42 which, at the ends of its arms is provided with slots 42a for the reception and mounting therein of a traction pin 43 or the like, for transfixing the lower fragment of the fractured femur,
55 thereby to provide for a mechanical application of traction. This construction of yoke and mounting and its manipulation are like that explained in my prior application filed on August 29, 1933, Serial No. 687,263.

The yoke, in this instance, is rotatably adjustable in the block 41 about the anatomical
60 axis of the limb applied thereto and this is by reason of its having its base arcuately curved and so mounted in the block 41 that when moved therein it will rotate bodily about a center that is at the point of intersection of the vertical
65 axis of rotation of the block and the pin 43. This rotative adjustment is made mechanically by hand rotation of a gear pinion mounted in the guide block 41 in operative mesh with gear teeth on the base bar of the yoke, as described in the applications above referred to.

In its functional use, the pin 43 transfixes the
70 lower end of the femur, and to effect an applica-
75

tion of tractive force to the fragment through the mediacy of the yoke, the cross bar 40 is adjusted along the base frame. This is accomplished by means of a threaded rod 45 that extends rotatably through the end bar 1 of the main frame and is threaded through a lug 46 on the cross bar 40; the shaft having a hand wheel 47 at its outer end for rotating it. Thus, through the mediacy of the yoke 42, the lower fragment of a fractured femur may be mechanically adjusted lengthwise and also rotated relative to the upper fragment.

Mounted on and extended beyond the end of the main frame is a foot rest comprising longitudinal extension rods 48-48, overlying the end bar 1 and joined at their inner ends by a cross bar 49 that is adjustable along the main frame to extend or retract the rods 48. Resting on the rods 48-48 is a frame comprising longitudinal members 50-50, upwardly curved at their outer ends and mounting a cross plate 51 on which the foot may rest as shown in Fig. 5. The members 50-50 are grooved to rest upon the rods 48-48 and at their inner ends have set screws 52 to lock them at adjusted positions on the rods 48-48.

Assuming the device to be so constructed, it is used in the following manner for the reduction of a fracture of the femur: First, the bracket 5 is adjusted laterally to the right or left side of the frame in accordance with its use for a right or left leg fracture. Then, the patient is placed with the buttocks resting upon the plate 32 and with the injured limb overlying and extended along the main frame, as indicated in dotted lines in Fig. 4, and with the foot supported by the foot rest 51. The well leg may be rested within a supporting seat 53 mounted at the end of a bracket 53' applied removably to a socket 54 in the table 4, as shown in Fig. 1. Then the insertion area of the hip is prepared and the half pin 22 is drilled perpendicularly into the trochanter at its distal edge. Then the angular fixation pin 23 is inserted just distal to the trochanter and is fixed in the bracket 20; over insertion is prevented by reason of the pin shoulders. Then the lower fragment is transfixed by the traction pin 43 at a location closely above the knee.

With these parts applied, and the patient properly adjusted on the supports and the bracket 20 applied to the clamp bolt of the adjustment rack and the pin 43 applied to the yoke 42, immediate approximation is rendered relatively easy by manipulation of the yoke and rack because of the direct mechanical adjustment of each fragment in contradistinction to the skill and patience demanded by current modes.

It is to be understood that the patient is so located relative to the splint that all adjustments of the superior fragment will be made on an axis corresponding with the center of the head of the femur and all lower fragment displacements are mechanically managed about the center of the shaft as the axis.

After proper reduction has been made, a cast is applied about the limb. This incorporates the traction pins 22-23 and bracket 20, and also the traction pin 43 therein, and thus the fragments are held positively in set position, and immediate crutch ambulation is thereby made possible.

In an alternative arrangement of the splint, a traction yoke, as is illustrated in Fig. 6, may be employed in lieu of the rack bar and pins. In this view, an extension piece 60 has been applied to the upper end of bracket 5 and is held by a bolt

61. The guide block 12 is mounted at the upper end of the extension piece in the same manner as previously described in connection with its mounting in bracket 5. A yoke 62 is mounted in the block and is adjustable in the same manner as is the rack bar in Fig. 2. The yoke arms mount a traction wire, or pin, 65 and they are offset at their ends from the axial plane of the yoke so that the wire or pin may transfix the femur directly through the trochanteric area as seen in Fig. 12. Adjustment of the yoke effects manipulation of the upper fragment similarly as with the use of the rack and half pins.

The same splint, with slight modification and change of relationship of parts, may be employed for reduction of fractures of the humerus. In this modification, as seen in Figs. 7 and 8, the table 4 and the lower end yoke are removed; a laterally extending bracket 75, corresponding to bracket 5, is attached to the upper end cross bar of the main frame. This bracket 75 mounts an arcuate rack 76 along which a block 77 is adjustably mounted. This latter block mounts therein the pins 22 and 23, as did the bracket 20 of the device previously described.

Fixed to the cross bar and extended lengthwise of the frame, is an upwardly curved bracket or arm 79 mounting a guide block 80 at its upper end in which is an adjustable yoke 81 carrying a traction pin 2. The arrangement described provides for effecting a skeletal connection with the upper fragment of the humerus by means of the pins 23-23 and a skeletal connection with the ulna adjacent the elbow joint by means of the pin 82. Reduction is simplified by the direct mechanical control of each fragment. Then, by incorporating the transfixations in an arm cast, complete immobilization is assured even from respiratory movements, and this results in not only a pain free convalescence but also in an early union. Straps of webbing fastened to a collar applied to the well shoulder may be used to hold an arm support.

In the use of the splint of Fig. 1, it is sometimes desirable to anchor the patient against movement, and for this purpose the base 4 is provided, as shown in Fig. 1, with sockets 90 for reception of anchor bars not shown, which may be shaped as is necessary and extended to a position alongside of the body of the patient so that they may be tied thereto by suitable straps or bandages.

It will be here mentioned that in place of the transfixation pins 22 and 23, it may be found desirable to use screws, which would be threaded into the fragment to provide a secure connection and as a means of limiting their extent of projection into the bone. Furthermore, other means than the shoulders shown on the pins might be employed to limit their extent of transfixation.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is:

1. A splint for the reduction of femur fractures comprising a base, and an attachment means whereby a direct plural point skeletal connection may be made with the upper fragment of the fractured bone for a positive manipulation thereof; said attachment means comprising a support rigidly mounted on the base and universally adjustable about the center of the femur head.

2. In a splint for the reduction of fractures of bones which have ball and socket articulation, a countertraction means adapted for fixed skeletal

connection with the superior fragment at a location removed from the center of articulation for a positive manipulation of the fragment, and a traction means adapted for connection with the distal fragment; said countertraction means having a support that is adjustable to permit a universal movement of the superior fragment about the center of articulation.

3. A splint for the reduction of fractures of the femur, comprising a base for the support of the fractured limb, a bracket attached to the base and adapted, when the splint is applied, to be adjusted about a vertical axis through the anatomical center of the femur head, and an attachment means mounted on the bracket whereby direct skeletal connection may be made with the superior fragment of the fractured bone for manipulation thereof; said attachment means being rotatably adjustable about an axis longitudinally of the limb passing through the center of the femur head.

4. In a splint for the reduction of fractures of the femur, a base frame, a means on the frame for the support of a patient under treatment, means on the frame for transfixing the lower fragment of the bone for the application of traction, and means on the frame for effecting a direct skeletal attachment with the superior fragment of the femur; said latter means being adjustable for rotation of the fragment about the anatomical axis and for a universal pivotal movement about the center of the femur head.

5. In a splint for the reduction of fractures of the femur, a base frame, a table on the frame for the support thereon of a patient under treatment, means adjustably fixed to the frame for transfixing the lower fragment of the bone and operable for the application of traction and for rotation of the fragment about the anatomical axis, an upwardly extending bracket pivotally fixed on the frame, means adjustably mounted by the bracket and including attachment pins for transfixing the upper fragment of the bone in angular relationship to each other, providing rigid connection therewith; said latter means being adjustable for pivotal movement of the fragment about the center of the femur head.

6. In a bone setting splint for femur and humerus fractures, a supporting frame, a traction means, a countertraction means pivotally movable about the joint center of the superior articulation, a skeletal attachment means adjustably mounted by the countertraction means and comprising a pair of transfixion pins mounted therein and adapted to transfix the bone in close angular relationship to each other for effecting rigidity of the attachment means.

7. In a splint for the reduction of fractures of bones which have ball and socket articulation, a countertraction means adapted for fixed skeletal connection with the superior fragment at a location removed from the center of articulation for a positive manipulation of the fragment, and a traction means adapted for connection with the distal fragment; said countertraction means having a support that is adjustable to permit a universal movement of the superior fragment about the center of articulation; said traction means being adjustable for reduction of the fracture and said countertraction means and the said traction means being adapted to be secured at their different positions of adjustment.

8. In a splint for the reduction of fractures of bones having ball and socket articulation, a base, a body rest on said base, a traction means on the base, a countertraction means fixed to the base adapted for a fixed skeletal connection with the superior fragment at a location removed from the center of articulation for a positive manipulation of the fragment and a carrier mounting the countertraction means and adjustably fixed to the base to provide a universal movement of the superior fragment about the center of articulation.

9. In a fracture reduction means, a pair of transfixion pins with inner ends sharpened for transfixion of a bone fragment, and a rigid manipulating bar mounting the pins therein and adapted for holding them rigidly in non-parallel relationship while their ends transfix the bone fragment whereby to maintain a positive fixed connection for manipulation of the fragment in the reduction of a fracture.

10. A fracture reducing means comprising a pair of pins with ends sharpened for bone transfixion by pressure, means on the pins and spaced from the sharpened ends for bone contact as a means of limiting the extent of the bone transfixion to slightly beyond the cortex opposite that which the pins first enter, and a rigid manipulating bar applied to and rigidly mounting the pins therein in angular convergence and in the same plane.

11. In a splint for the reduction of fractures in bones having ball and socket articulation, a base, fracture reducing means on the base comprising a traction member for holding the distal fragment, a countertraction member including means for a direct, fixed connection with the superior fragment from the lateral aspect, and for the positive manipulation and rigid holding of that fragment, and a support on the base for said countertraction member whereby it is adjustable about the center of articulation for reduction of the fracture.

12. A method of reducing fractures of bones wherein the superior fragment has ball and socket joint articulation, comprising holding the distal fragment for reduction, applying transfixion members to the superior fragment from the lateral aspect without incision, fixing said transfixions in a support and adjusting the support to bring the fractured parts into apposition.

13. The method of immobilizing a fragment of a fractured bone in a limb of the body comprising inserting two transfixion pins through the fragment from the same side and in angular relationship, fixing the external ends of the pins in a rigid connecting means, applying a cast to the limb containing the fracture, and imbedding the said rigid connecting means in the cast.

14. The method of immobilizing a fractured limb which comprises skeletally transfixing one of the fragments by means passing through the limb, inserting two transfixion pins through the other fragment from the same side and in angular relationship, fixing the external ends of the pins in a rigid connecting means, reducing the fracture by manipulation of the connecting means; then applying a cast to the limb containing the fracture and imbedding the said transfixion means first mentioned and the said rigid connecting means in the cast.

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