May 14, 1940. R. ANDERSON 2,200,407

FRACTURE REDUCING AND IMMOBILIZATION SPLINT

Filed Jan. 18, 1937 6 Sheets-Sheet 1

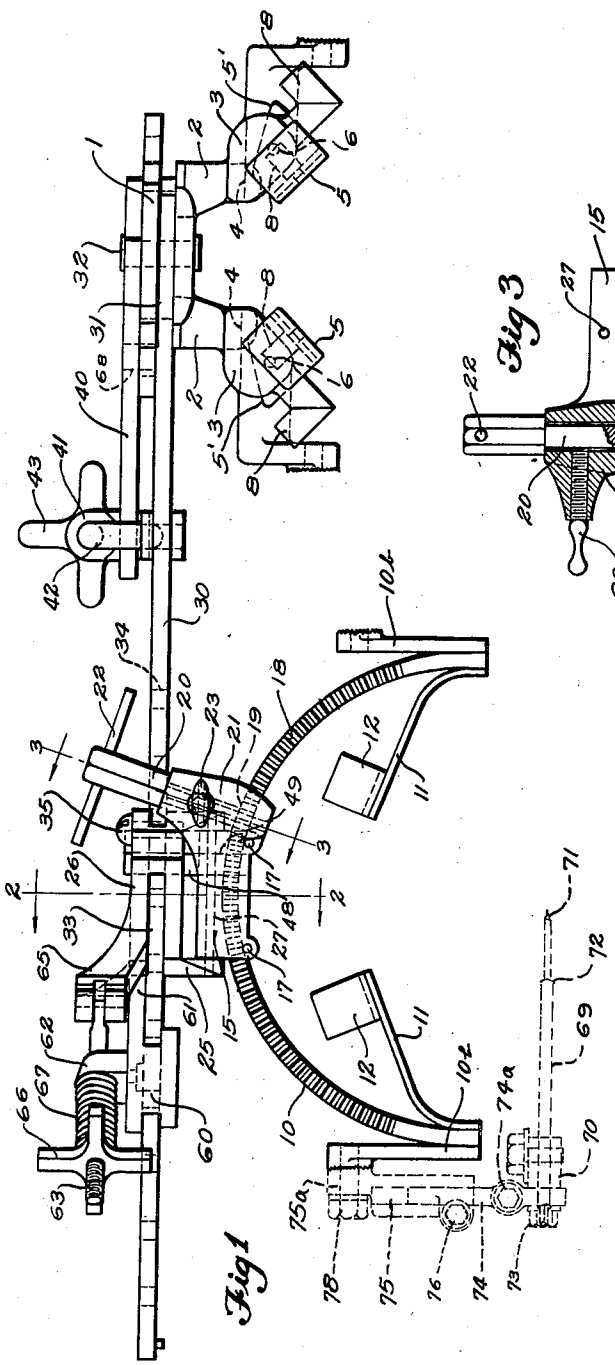


Fig 1

Fig 3

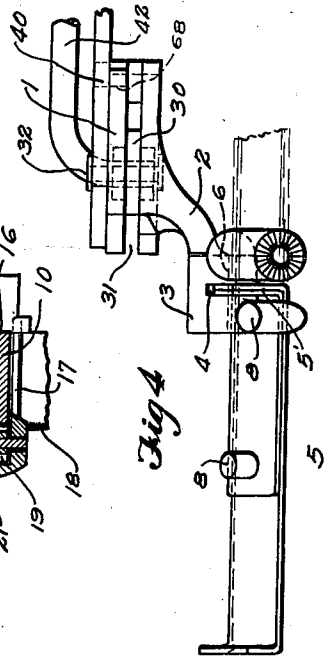


Fig 4

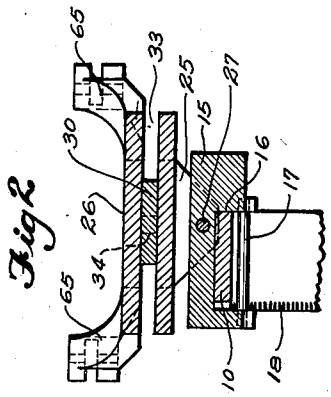


Fig 2

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FRACTURE REDUCING AND IMMOBILIZATION SPLINT

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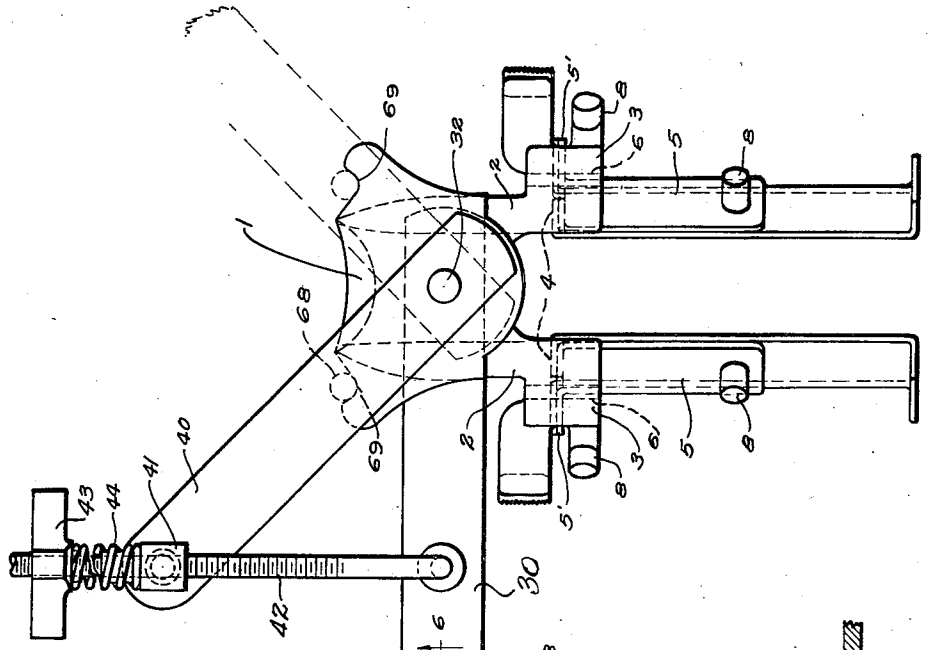


Fig 5

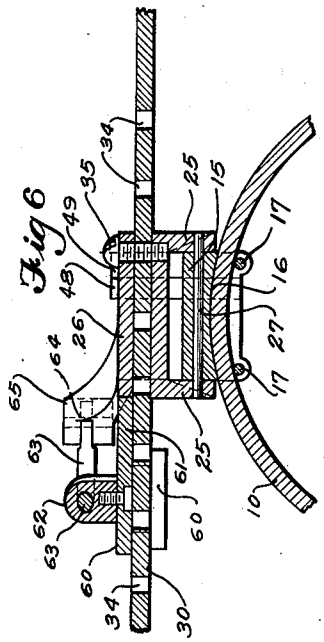


Fig 6

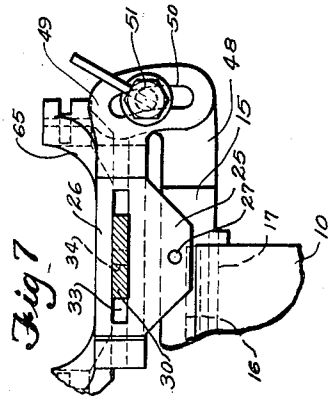


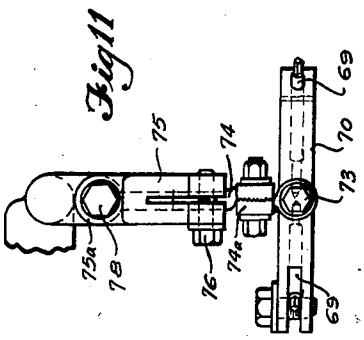
Fig 7

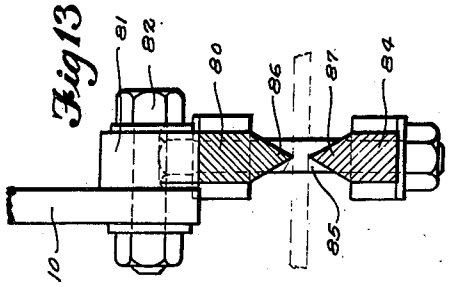
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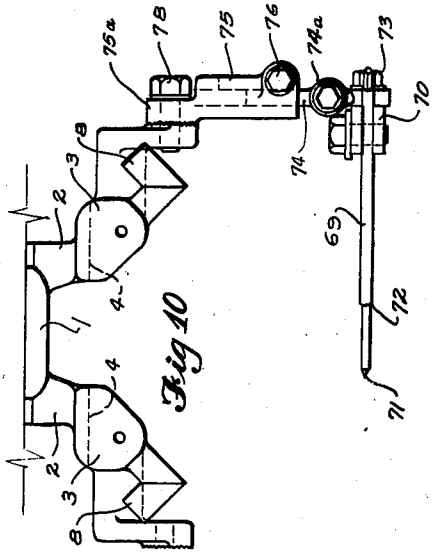
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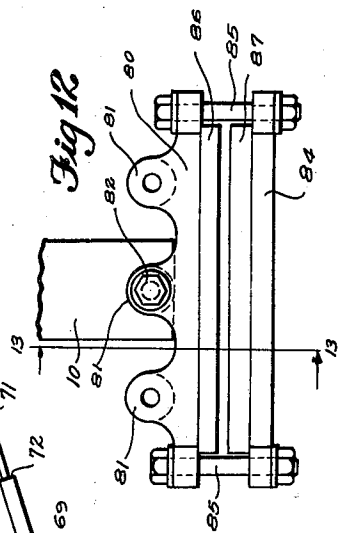
FRACTURE REDUCING AND IMMOBILIZATION SPLINT

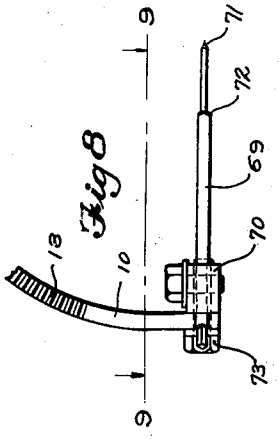
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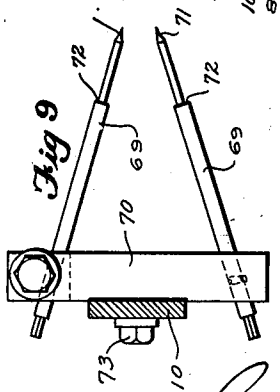












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FRACTURE REDUCING AND IMMOBILIZATION SPLINT

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Fig 16

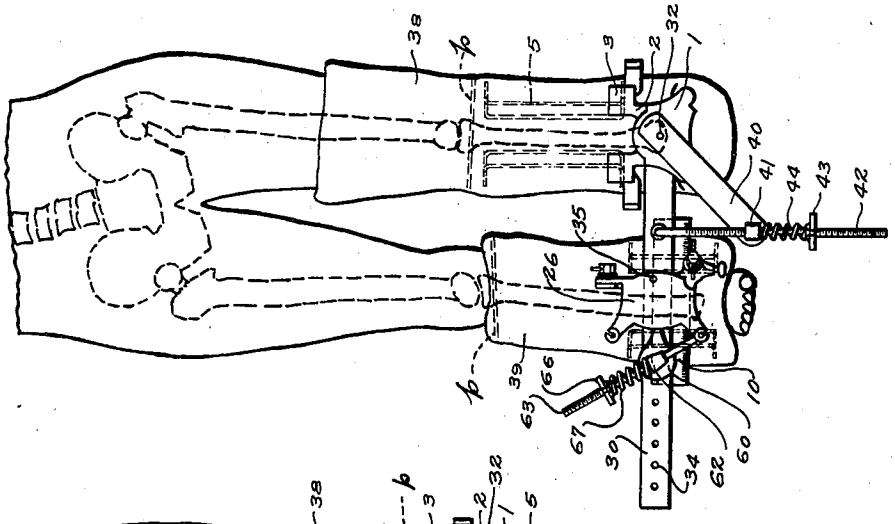


Fig 15

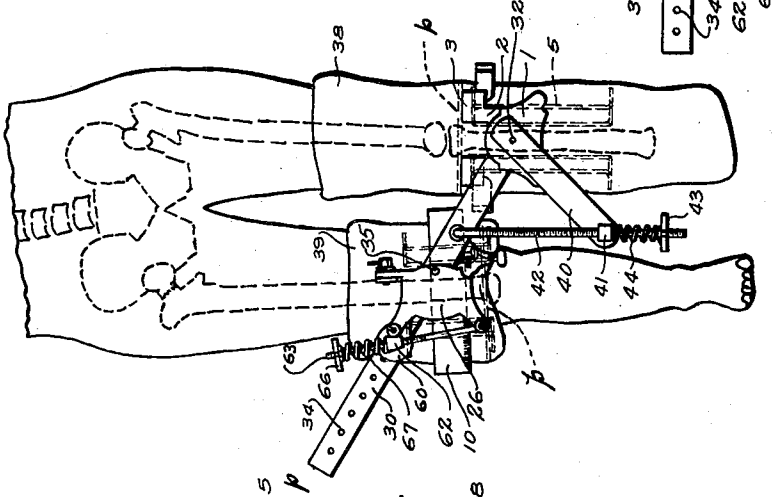
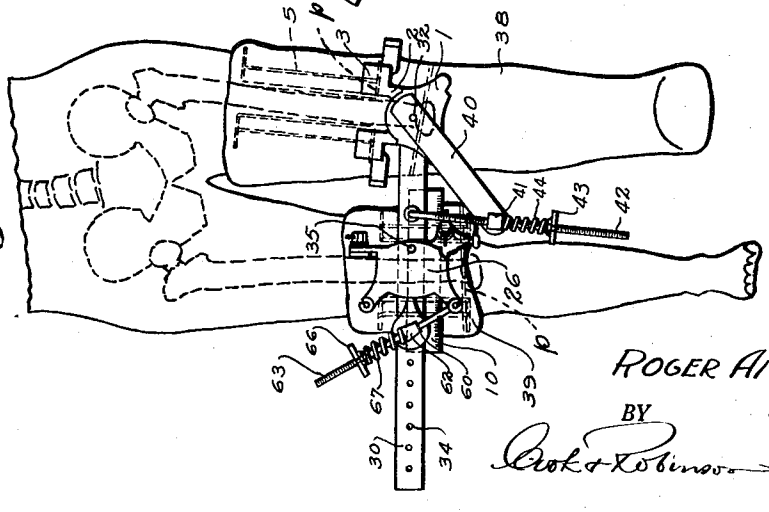


Fig 14



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FRACTURE REDUCING AND IMMOBILIZATION SPLINT

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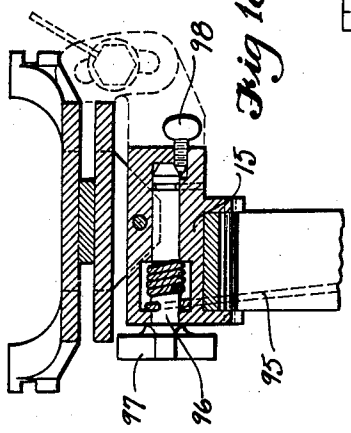


Fig 18

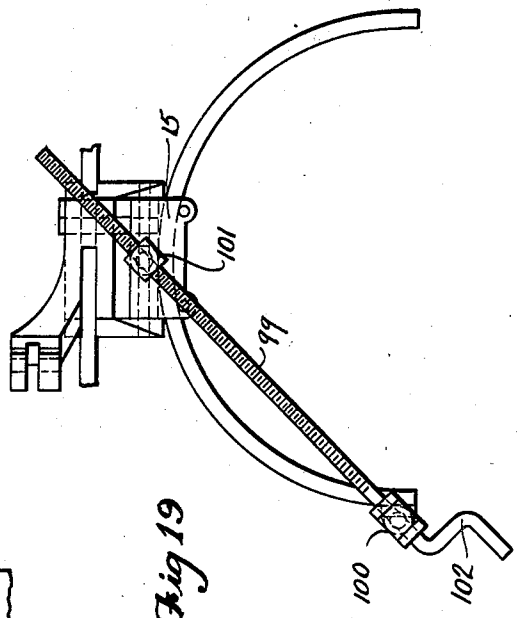


Fig 19

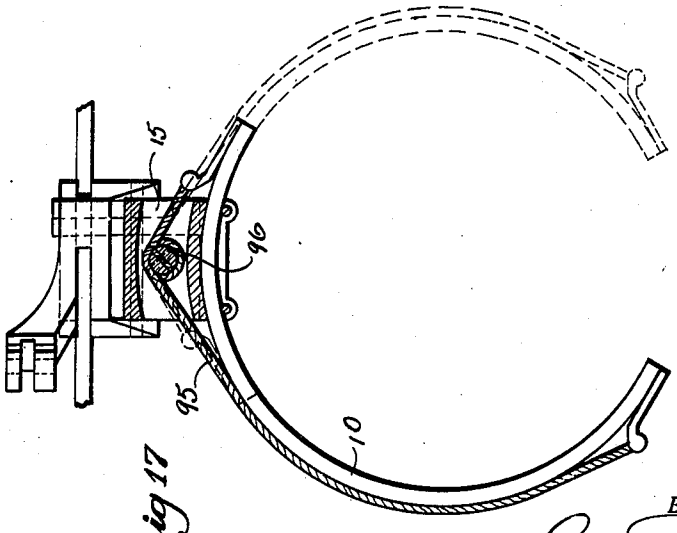


Fig 17

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FRACTURE REDUCING AND IMMOBILIZATION SPLINT

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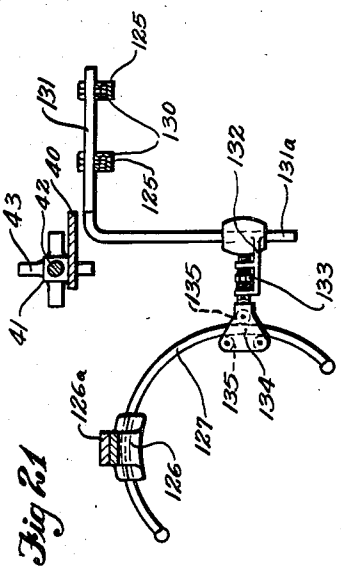


Fig 21

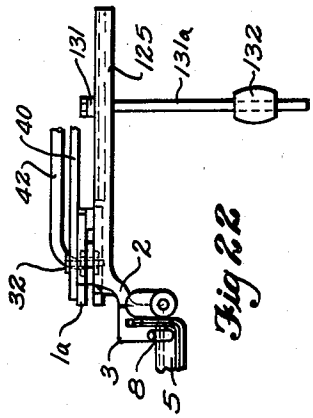


Fig 22

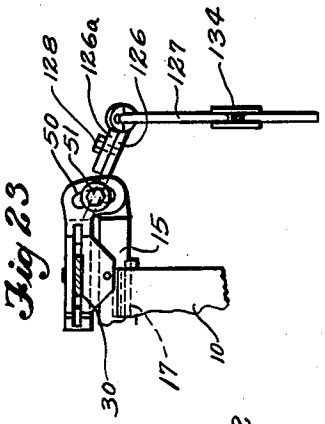


Fig 23

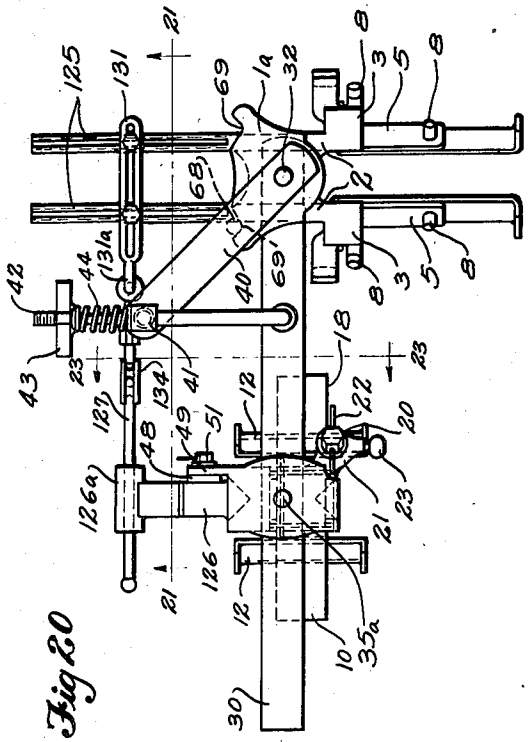


Fig 20

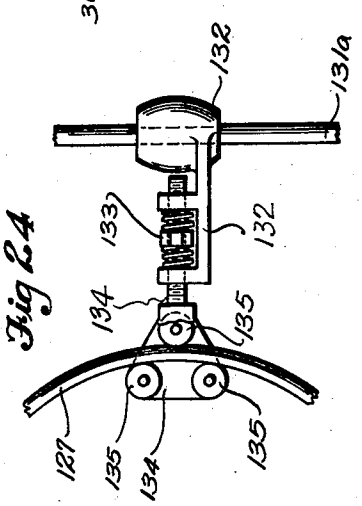


Fig 24

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Patented May 14, 1940 2,200,407

UNITED STATES PATENT OFFICE

2,200,407

FRACTURE REDUCING AND IMMOBILIZATION SPLINT

Roger Anderson, Seattle, Wash.

Application January 18, 1937, Serial No. 121,146

15 Claims. (Cl. 128—84)

This invention relates to fracture reducing splints of that type employed for mechanically reducing and immobilizing a fractured leg of the human body.

More specifically stated, the invention relates to splints of that character whereby a tractive force mechanically applied to the fractured leg may be sustained as countertractive force by the other leg; such, for example, as provided for in the splint of my U. S. Patent No. 1,928,658, issued October 3, 1933, and also by the splint of my copending application, filed on March 2, 1935, under Serial No. 9,061, now Patent 2,129,635, granted Sept. 13, 1938.

Optimal end-results from treating fractures of the neck, inter-trochanteric and sub-trochanteric fractures, presupposes not only perfect reduction, but such immobilization that bony union results in the minimum time. Previous methods and devices have been directed chiefly toward effecting primary reduction, but neglected to supply fixation throughout convalescence with consequent frequency of non-unions.

In the past, practice according to the generally accepted method of Whitman has resulted in excellent initial reduction, but has failed to insure or hold apposition, with the result of non-unions. Non-unions also have resulted from loss of contact between fragments due to absorption of bone from the distal end of the superior fragment, as is evidenced by a study of radiographs taken during convalescence.

In view of the above facts, as briefly stated, I have concluded that to obtain union, it is imperative, first, to have perfect reduction, and, second, to have immobilization secured with constant fragment contact. Therefore, with these things in mind, and with the objective of obtaining bony unions in a higher percentage of cases, it has been the principal object of this invention to provide a contact method, and novel apparatus for carrying it out, whereby reduction, immobilization and constant contact is insured.

In the device of the above mentioned patent, the frames for effecting connection with the two limbs and through which the tractive and countertractive forces are applied, are disposed at the lower extremities of the two limbs, while in the device of the pending application, a countertraction frame is arranged for cast connection with the well leg at a location below the knee and a traction frame is arranged opposite thereto for skeletal connection, through the mediacy of a cast and transfixion pins or wires, with the fractured limb. In each case, a lever mechanism connects the countertraction frame and the traction member and is adjustable mechanically in a manner whereby tractive force may be applied to the fractured limb and sustained, as countertraction, by the well limb. However, there is no means in either of these devices for insuring constant contact of the fracture fragments.

The present invention also has for its object to improve upon the splints of the above patent and application, by use of parts, so designed and arranged, that it may be applied at various locations between the ankles and thighs, for example, with both the traction and countertraction frames secured to the legs at points above the knees, or both secured to the legs below the knees, or one secured above and the other below the knees. Furthermore, to provide for a more universal adjustment of the traction frame so as to make it possible to easily bring the fractured fragments into proper apposition with the splint applied, to immobilize, and also to maintain constant contact all during convalescence.

It is a further object of this invention to provide a splint wherein the traction frame is so designed and mounted in the splint that it may be mechanically rotated and angularly adjusted, to thereby effect a similar adjustment of the fragment to which it is attached. Furthermore, a splint wherein the traction frame is so mounted that an application of tractive force automatically effects a movement of the lower fragment into contact with the superior fragment.

Other objects reside in the details of construction, and in the combination of parts embodied in the device and in the method practised by use of the present device, as will hereinafter be described.

In accomplishing the above mentioned and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is an elevation of the splint, in one of its preferred forms of construction.

Fig. 2 is a cross sectional detail, taken on the line 2—2 in Fig. 1, particularly illustrating the mounting of the traction yoke.

Fig. 3 is a cross sectional detail on the line 3—3 in Fig. 1, showing the means for rotatably adjusting the traction yoke, and the means for securing it in different positions of adjustment.

Fig. 4 is an end view of the splint, particularly showing the anchor bars to be incorporated in the well leg cast.

Fig. 5 is a top or plan view of the splint.

Fig. 6 is a fragmental, sectional detail longitudinally of the splint, as on line 6—6 in Fig. 5.

Fig. 7 is a cross section on line 7—7 in Fig. 5, showing the means for holding the traction yoke block at different positions of adjustment.

Fig. 8 is a detail illustrating the means for securing skeletal transfixion pins on an arm of the traction yoke.

Fig. 9 is a horizontal section on line 9—9 in Fig. 8, showing the angular disposition of the traction pins.

Fig. 10 is a detail, illustrating an attachment device for skeletal connection as applied to the well leg frame.

Fig. 11 is a side view of the attachment.

Fig. 12 is a side view of one of the transfixion wire or rod mounting clamps to be used with the traction or anchor yoke.

Fig. 13 is a cross section on line 13—13 in Fig. 12.

Figs. 14, 15 and 16 are views illustrating different positions of application of the splint for fracture reduction.

Fig. 17 is a detail illustrating an alternative means for rotatably adjusting the traction yoke.

Fig. 18 is a cross section on line 18—18 in Fig. 17.

Fig. 19 is an illustration of another form of yoke adjusting means.

Fig. 20 is a plan view of a device of an alternative construction.

Fig. 21 is a cross sectional view of the same on the line 21—21 in Fig. 20.

Fig. 22 is an end view of the well leg mounting block.

Fig. 23 is a sectional view on line 23—23 in Fig. 20.

Fig. 24 is a detail of the adjusting means of the device of Fig. 20 and Fig. 21.

Referring more in detail to the drawings:

In accordance with the objects of the present invention, a splint is designed in such manner that when applied, tractive force effected thereby for the reduction of a fracture in one leg, which hereinafter will be designated as the injured leg, will be sustained as countertraction by the other leg, which hereinafter will be referred to as the well leg. This is accomplished in this device preferably by fixedly securing a suitable anchor frame to the well leg through the mediacy of a cast and skeletal transfixion pins, and likewise applying a traction frame to the injured limb and operatively connecting the countertraction and traction frames by a lever mechanism that is adapted to be adjusted, by mechanical means fixed to the lever and to one of the frames, in a manner to effect a relative movement of the frames lengthwise of the body to cause a tractive force sustained by the countertraction frame, to be applied to the traction frame.

In the following description, the frame structure that is attached to the well leg for sustaining the traction that is to be applied to the injured leg will be referred to as the anchor frame for the reason that it is the anchor against which the tractive forces are applied. Also the traction frame will be understood to be the frame structure that is attached to the injured limb and through which traction or tractive force are applied to the injured limb.

Provision is likewise made whereby all necessary rotatable or angular adjustments of the traction frame may be made while the splint is applied to bring the bone fragments into proper apposition, and other means operates to yieldingly maintain fragment contact during the period of healing.

First, describing the splint in its form as shown best in Figs. 1 and 5: The well leg frame comprises a casting 1 in the nature of a block, having a flat top surface and from the under side of which block, two spaced and downwardly directed legs 2 and 2 extend. These legs are equipped with feet 3—3, and these have transversely directed slots 4 formed therein to adjustably contain the upturned ends 5′ of a pair of anchor bars 5 and 5. Pivot pins 6, extended through the feet and the ends 5′ of the bars, hold the bars in place, but permit rotative adjustment thereof about the axial lines of their respective supporting pins 6. The two bars 5 and 5 are parallel, and when the splint is applied to the well leg, these bars are incorporated in the cast lengthwise of the leg, thereby to effect a solid and effective connection with the limb.

The feet 3 of the block and also the bars 5 and 5 are provided with studs 8 about which bands of tape may be applied as an aid to holding the device firmly in the cast.

The means for effecting a connection with the injured leg comprises a traction yoke 10 of such size as to embrace the limb and cast, and formed from a flat bar bent to substantially semi-circular form. Fixed to the opposite legs of the yoke and disposed on the inside thereof, are supports 11 and 11, as shown best in Fig. 1. Fixed to the ends of these supports are short anchor bars 12 and 12, extended lengthwise of the leg, as applied to the splint, and designed to be embedded in the cast that is applied to the injured leg so as to form a secure connection therewith through which tractive forces may be applied to the fractured member.

The yoke 10 extends slidably through a mounting block 15 which overlies it, as shown in Fig. 1; the block being provided with a transverse slot 16 in which the curve of the yoke seats, and with pins 17 which are fixed in the block and extend across the slot beneath the yoke bar to hold it slidably in the seat, but permitting rotative adjustment of the yoke about its axis of curvature.

For purpose of adjustment, the yoke bar is equipped along one edge with gear teeth 18, and a small adjusting gear 19 is fixed on a hand shaft 20 in mesh therewith. The shaft 20 is rotatably contained in a supporting bearing 21 on the block 15 and has a handle 22 whereby it may be rotated to effect an adjustment of the yoke. Also, a set screw 23 is threaded into the bearing in position to be tightened against the shaft 20 to hold it against rotation and to thereby hold the yoke at any position of adjustment.

The block 15, which mounts the yoke, is in turn pivotally secured between depending ears 25 and 25 of a supporting slide block 26 by means of a pin 27; the pin being extended in the direction of the plane of the yoke, which plane is perpendicular to the axis of curvature of the yoke.

The frame for the well leg and that for the injured leg are connected together by a lever bar 30. This bar is contained at one end within a slot 31 cut horizontally through block 1, wherein it is pivotally fixed by a stud or pin 32. The opposite end portion of the bar extends through a horizontal recess or slot 33 in the slide block 26, and the latter block is adjustable along the bar to change the spacing of the two frames, and in order that it may be held at any of its

different positions of adjustment, the bar is provided at spaced intervals with holes 34 and a screw bolt 35 is mounted in the block to be extended through any of the holes to which the block may be adjusted. The slot 33 is of such size, however, that the block 26 has a pivotal movement about the bolt as an axis. Also, it is a feature of this arrangement that the axial line of bolt 35 is inset from the center of yoke 10 as a means of effecting an automatic contact of fracture fragments as will presently be understood.

When the device is in use, it may be applied to the limbs in various ways, as shown in Figs. 14, 15 and 16; depending upon the location of or character of the fracture. In most instances the frame for the well leg would be anchored in a cast 38 which would extend from a location above the knee to a point at least adjacent the ankle, but preferably including the foot. The frame applied to the injured leg would likewise be anchored in a cast, 39, which would be relatively short. It is preferred also that the casts be skeletally anchored to the limbs by means of pins, wires, or the like P embedded in the cast and transfixing the bones, as indicated.

In order that tractive force may be applied to the injured leg frame and sustained, a short lever arm 40 is fixed on block 1, and this is angularly disposed relative to the normal position of the lever 30, as seen in Figs. 5, 14, 15 and 16. This lever, at its outer end, has a block 41 pivotally mounted therein and through which a threaded shaft 42 is slidably extended. One end of the shaft has pivotal connection with the lever 30 at a point intermediate the frames, and on its other end has a wing nut 43 threaded thereinto. A coiled spring 44 is interposed between the wing nut and block 41 to yieldingly sustain the pull or tractive force that may be applied by adjusting the nut inwardly on the shaft.

When the splint is applied, it sometimes becomes necessary or desirable to adjust the yoke supporting block 15 in a manner whereby to change the plane of the yoke relative to the horizontal plane of the bar 30. This adjustment is accomplished by means best shown in Fig. 7, wherein the block 15, which is shown as being supported from slide block 26 by the pivot pin 27, has an arm 48 extended from one side thereof into overlapped relation with an arm 49 extended from block 26. The arm 49 has slot 50 formed therein, arcuately about the axis of pin 27 and a headed locking bolt 51 is extended through this slot and threaded into the arm 48 and is adapted to be tightened against arm 49 to hold the block 15 at any set position of inclination relative to block 26 within its limits of adjustment.

It is also desirable that means be provided whereby the slide block 26 may be swung one way or the other relative to the lever bar 30 about the pivot center of bolt 35, thus to change the angular position of the yoke relative to the leg and incidentally to move the bone fragment, to which it is attached, accordingly. For this latter adjustment, there is provided a block 60 slidable on the outer end portion of the lever 30 and having a lateral arm 61 adapted to engage against the block 26, as shown in Fig. 5. A bearing 62 is pivoted upon the block 60 and through this is slidably extended a threaded shaft 63, pivotally connected at one end, as at 64, with an arm 65 extended from the block 26. A wing nut 66 is threaded on the other end of the shaft to act against a coiled spring 67, which surounds the shaft between the nut 66 and bearing 62, and yieldingly retains the block 15 in the position to which it may be adjusted by manipulation of the nut.

In order that this device may be reversed for treating fractures of either leg, it will be observed that the lever 40 is pivoted on the stud 32 and may swing to either side of the block 1, as indicated by its dotted line position in Fig. 5. When it is at either position, it is held there by a stud 68 fixed therein and engaged against a shoulder 69 on the block. Likewise, the slide block 26 is provided at opposite sides of the lever 30 with arms 65 and the shaft 63 may easily and readily be detached from one and applied to the other to suit the occasion.

In some instances of use of this splint, it may be impossible or inadvisable, by reason of the character of the injury, to apply a cast to one or both of the legs. Therefore, provision has been made for skeletal connection directly with the frames of the splint instead of connection through the mediacy of the plaster casts.

In Figs. 10 and 11 has been shown attachment means whereby skeletal connection may be made with the well leg frame by means of what are known in the art as "half pins." In making a connection, these half pins 69 are used in pairs and they are fixed in angular convergence in a holding bar 70, as illustrated in Fig. 9. The inner end portions of these pins are sharpened as at 71 for piercing the bone and are provided at a spaced interval from the sharpened ends with shoulders 72 to limit their extent of transfixion. The bar 70 which mounts the pins is fixed by a bolt 73 extended therethrough to a standard 74 which is jointed as at 74*a* for universal adjustment of bar 70, and is adjustable lengthwise in a split bracket 75, and adapted to be held at different positions of adjustment therein by a clamping bolt 76 threaded in the bracket. Each of the brackets 75 also is provided at its upper end with a head portion 75*a* through which a locking bolt 78 may be extended to lock the bracket to one of the legs 2 of the well leg frame. This attachment device may be used at one or both sides of the frame, as desired, and the manner in which the brackets are mounted permits them to be adjusted forwardly or rearwardly about the pivot 78 and the bar 70 to be raised and lowered, or tilted to different positions by reason of the pivots 73 and 74*a*.

The same type of half pin mounting bar as shown in Fig. 10 may be applied to the ends of the yoke arms, as illustrated in dotted lines in Fig. 1, which shows the yoke arms to be equipped with brackets 10*b* to which the brackets 75 may be applied after the fashion they are applied in Figs. 10 and 11, so that instead of attaching the yoke 10 to the limb through the mediacy of a cast, direct skeletal connection may be made by the half pins. It is to be understood that the angular convergence of the half pins prevents their being loosened or disengaged from the bone after they have both been applied thereto and locked on the bar. The manner in which they are disengaged comprises releasing one of the pins from bar 70 and extracting it from the bone; then releasing and extracting the other pin.

When it is desired to extend transfixion pins or wires entirely through the bone, instead of using the half pins, I employ clamp devices for securing opposite ends of the wire or pin. Such a clamp has been illustrated in Figs. 12 and 13.

These clamps may be attached to the opposite ends of the yoke 8 or to the opposite legs of the well leg frame. Each clamp comprises an upper bar 80 provided with a series of apertured lugs 81 along its top edge to receive a locking bolt 82 therethrough for connecting it either with the leg of the frame or with the end of the yoke. Also, it comprises a lower clamp bar 84 attached at its ends to the upper bar by connecting bolts 85. The upper and lower bars have opposedly disposed sharpened ridges 86 and 87 adapted to be clamped against the ends of the transfixion pins or wire, as in Fig. 13. It will be observed by reference to Figs. 12 that the clamp bars are relatively long and that this permits quite a range of adjustment for the transfixion pin.

In Fig. 17 has been illustrated an alternative means for effecting a rotary adjustment of the yoke 10. In this arrangement, it is not required that the yoke be gear toothed. A cable 95 is wound several times about a turning shaft 96 revolubly contained in the block 15 with opposite ends of the cable extended and attached to opposite ends of the yoke. A handle 97 is fixed on the shaft whereby it may be rotated thus to shift the yoke accordingly. A lock screw 98 is threaded into the end of bearing 15 against shaft 96 to retain it against turning after an adjustment has been made.

In Fig. 19 is illustrated still another form of adjustment. In this a threaded shaft 99 is revolubly fixed at one end in a bearing 100 secured to the end of yoke 10. The other end of the shaft is threaded through a nut 101 that is pivotally fixed on the block 15. By turning the shaft by means of a crank 102 at its end, the yoke will be slidably shifted in its mounting.

In Fig. 20 there is illustrated a modification of the splint which varies from the preferred construction in that a pair of parallel bars 125—125 are fixed rigidly to the block 1*a* and are extended therefrom in the longitudinal direction of the leg and adapted to overlie the leg when the latter is applied thereto. The mounting block 26 for the injured leg traction frame is centrally pivoted at 35*a* on the traction lever 30, and it has an arm 126 extended therefrom to overlie the injured leg. A semicircular bar 127 is slidably fixed in the end of the bar 126 for rotary adjustment about the axial line of the limb. This may be held in place by a clamp bar 126*a* which overlies the rod 127 and which is fixed to the bar 126.

In this modification, the pivotal connection of the traction frame with the traction lever is not offset from the line of the injured leg as in the previously described device, but is centrally located thereover. Therefore, when traction is applied, there will be no tendency to swing the fractured fragment inwardly or outwardly. In order that this inward or outward adjustment of the fractured member may be accomplished, a connection is provided between the arcuate bar 127 and the bars 125. By reference to Fig. 21, it will be observed that there is an anchor bar 131 fixed by bolts 130 to the bars 125. This anchor bar has a downwardly depending leg 131*a* on which a bracket 132 is slidable and rotatable. The bracket is yieldingly connected through the mediacy of a turnbuckle nut 133 with a bracket 134, through which the arcuate bar 127 is slidably adjustable. Rollers 135 mount the latter bracket on the arcuate bar, and it is apparent that by adjustment of the turnbuckle, the bar 127 may be moved bodily toward or from the depending leg 131*a*. Thus, the fractured member of the injured leg, when fixed in the traction frame, may be adjusted toward or from the well leg.

In this modification of Fig. 20, adjustment of the traction yoke 10 is accomplished in the same manner as in the device of Fig. 1, and the frame may be tilted in the same manner, and traction is applied through manipulation of the nut 43 mounted on the connecting rod 42, which extends between the traction lever 30 and the bracket arm 40.

The routine technique for use of the present splint as applied in Fig. 14, briefly described, is as follows: First, X-rays should be taken to determine the character of the break. Then the region of both knees is surgically prepared, and this is followed by a cleaning with ether and a painting with iodine of proper strength. Under a local anesthetic, a transfixion, either pin or wire, is inserted through the injured femur at the superior edge of the condyles, approximately two fingers' breadth superior to the knee joint. A second transfixion is put through the upper, flared-out end of the well tibia at a level halfway between the knee joint and the tibial tuberosity, one finger's breadth distal to the knee joint. Dry dressings are spiked over the pins and held in place by bandaging with non-sterile sheet wadding.

While the assistant holds the well leg in abduction at the hip, a padded or unpadded cast is applied from the upper thigh at least to the lower calf. In older patients, the cast is extended beyond the toes so as to keep the foot at right angles, to keep the covers off the toes. A wire or pin is securely incorporated in the plaster. The distal, lateral edge and the superior medial portion of the cast are padded with thin pieces of felt, the size of one's hand.

On the injured side, the plaster cast extends from a few inches below the knee to the midthigh. Here again the transfixion must be solidly fastened into the cast.

A few minutes later, the patient is pulled down until the legs up to the mid-thighs project over the end of the table. Then the heels are rested on a pillow on a second table of the same height. With both legs in mid rotation, the splint is placed on the casts with the raised portion of the well leg side of the splint placed directly over the patella. On the injured side, the rotation quadrant 10 is placed about three fingers' breadth superior to the patella.

With a single 6-inch plaster, the well leg part of the splint is incorporated by bandaging the plaster lugs into the cast, accomplished by passing the bandage in a criss-cross manner posterior to the cast. The other side of the splint is similarly attached.

After a few minutes, the traction nut 43 may be tightened. At first, the injured leg is only drawn down if the patellae are opposite each other, but in a few hours' time, or the next day, the leg is pulled down farther, until it appears to be about two inches longer.

In fractures through the neck of the femur, the leg is internally rotated through the medium of the adjusting gear and the teeth on the yoke, while in most of the intertrochanteric fractures, the leg is kept in mid-rotation, and the degree of rotation is gauged from the check-up X-rays.

In the arrangement as shown, it will be understood that, assuming the device is applied as in Figs. 14 or 15, and assuming the fracture to be in the neck of the femur head, when traction is

applied by pulling down on the lever 30, this pull will be transmitted to the yoke 10 through the mediacy of the slide block 26. However, since block 26 is connected to lever 30 by the screw 35 which is located inside of the line of the center of yoke 10, there will be a lateral force applied to the fractured bone whereby its fractured end will be swung into contact with the superior fragment even though under tension or traction. If this lateral pull is not sufficient, then it may be augmented by use of the shaft 63, on which nut 66 is threaded to act against spring 67 which effects a constant but yielding pull on the block 26.

If it is desired to tilt the fragment upwardly or downwardly, this may be accomplished by an adjustment of the block 15' by reason of its being pivoted on pin 27 and having the pin and slot connection at 50—51 as seen in Fig. 7.

In most cases, it is advisable not to connect the contacter mechanism embodied in the shaft 63 and nut 66 until after a few days have passed. The end of the rod 63 is then connected and then, by turning down the nut 66, the springs will be compressed, and this will provide a yielding force to be exerted through the skeletal connection, which will keep the bone fragments in constant contact in spite of the inevitable absorption at the fractured end of the central or head fragment. As absorption takes place, the spring automatically takes up the shortening.

In certain inter- and sub-trochanteric fractures, this connection is made the next day after application of the splint. In this case, the contacter action is reversed so that the upper end of the shaft fragment can be pulled laterally to overcome the displacing pull of the adductor muscles upon the upper end of the distal fragment.

After-care would contemplate that when the plaster cast has dried, it is cut out over the patella on the well side and over the patella on the injured side and back of the knee, leaving little extensions of the casts projecting down beyond pins over the sides of the knee joint. As the reduction can usually be accomplished under morphine, the patient is immediately placed on a back-rest, and up in a wheel-chair in a few days' time, and if indicated, the patient may be turned over on abdomen as often as necessary. The knee on the injured side may be moved as soon as the patient is up in the chair, while the patella on the uninjured side is manipulated and moved several times a day. X-rays should be repeated to check up on position. The contacter action is usually sufficient when the spring 67 is only slightly compressed, but the tension should be enough to keep the fractured surfaces always in direct contact. Pain in the well hip is the danger signal which means too much traction, while pain in the injured hip indicates too little traction.

This apparatus may be used for man, woman or child. For patients of different size, the splint may be adjusted by selecting the different attachment holes 34 in the traction level for receiving the pivot pin 35. However, the main parts of the splint should be kept as close together as possible, because, paradoxical as it may seem, better abduction action is obtained when the legs are parallel to each other.

A large number of variations are possible while still operating on the same basic principle. For example, the transfixions may be placed in distal ends of each tibia with a short cast on the injured leg from toes to upper calf and on the well leg from toes to mid-thigh. In this event, the splint is fastened anterior to the distal tibia. No transfixion of the well leg is necessary provided the sole of the foot is utilized for counter-traction.

Still another procedure is to place two transfixions at an angle to each other into the distal part of the well femur. This technique calls only for a short cast on the well thigh from the knee to the upper thigh.

Another variation is to use a half pin unit placed into the distal femur from the lateral aspect of either one or both femurs with casts only to the thighs. With the above transfixion combinations, both knees, both ankles and both hips are left free to move while the fracture is still firmly immobilized.

All the advantages that are to be found in the patent previously mentioned, and the device of the application pending, are to be found in the present splint, with the added advantage of the constant contact and the greater freedom of adjustment.

Also, a front to back adjustment of the distal fragment is possible. With the splint in place, all joints may be exposed and free to move. With a shoe placed on the foot of the well leg, crutch ambulation is possible.

Furthermore, the present splint has the advantage that the knee on the injured side may be moved from the first day without danger of displacing fragments, and with this technique, the percentage of bony unions will be higher than by any other known method.

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

1. A reduction and immobilization splint for leg fractures, comprising an anchor frame adapted for fixed connection with the well leg, a traction frame adapted for a fixed skeletal connection with the injured leg at a point below the fracture, a lever mechanism connecting the frames and adjustable to effect an application of tractive force to the traction frame; said traction frame having a connection with the lever permitting upward and downward tilting of the frame relative to the plane of the legs, and means for sustaining an adjustment of the traction frame about the said connection.

2. A reduction and immobilization splint for leg fractures, comprising an anchor frame adapted for fixed connection with the well leg, a traction frame adapted for fixed skeletal connection with the injured leg below the location of the fracture, a lever mechanism connecting the frames, a lever adjusting means on one frame whereby the said lever may be moved to effect the application of tractive force to the traction frame, pressure exerting means connecting the lever and traction frame whereby the latter frame may be acted on to effect a lateral application of pressure on the fractured fragment.

3. A reduction and immobilization splint for leg fractures, comprising an anchor frame adapted for fixed connection with the well leg, a traction frame adapted for fixed skeletal connection with the injured leg below the location of the fracture, a lever mechanism connecting the frames, a lever adjusting means on one frame whereby the said lever may be moved to effect a yieldable application of tractive force to the traction frame, a pressure exerting means connecting the lever and traction frame whereby the latter

frame may be acted on to effect an inward or outward application of lateral pressure on the fractured fragment and means in said connection whereby it may be held under a yielding pressure whereby fragment contact is retained.

4. A fracture reduction and immobilization splint for leg fractures comprising an anchor frame adapted for fixed connection with the well leg, a traction frame adapted for fixed skeletal connection with the injured leg at a point below the fracture, a lever connecting the frames, means for adjusting the lever to effect an application of tractive force to the traction frame to be sustained by the well leg through the anchor frame; said traction frame comprising a traction yoke embracing the leg and including means through which connection is made with the leg, a mounting block for the yoke permitting sliding adjustment of the yoke therein to effect axial rotation of the leg while under traction, a slide block mounted pivotally on the lever, and pivotally mounting said yoke mounting block therein to permit upward or downward tilting of the traction frame relative to the plane of the legs, and a releasable locking means whereby the said yoke mounting block may be held at different positions to which it may be tilted.

5. A fracture reducing and immobilization splint comprising an anchor frame adapted for fixed connection with the well leg, a traction frame adapted for fixed skeletal connection with the injured leg, a lever arm fixed on the anchor frame, a bearing member pivoted therein, another lever pivotally mounted on the anchor frame and having pivotal connection with the traction frame, a threaded shaft pivotally connected with the lever arm and lever and slidable through said bearing member, a coiled spring surrounding the shaft and engaging said bearing, a nut threaded on the shaft and seated against said spring; said nut being adjustable to effect a yieldable application of tractive force to the traction frame sustained by the anchor frame, a bearing on the lever at a point beyond the point of connection of the traction frame with the lever, a threaded shaft pivotally attached to the traction frame and slidable through said bearing, a coiled spring on said shaft and seated against the bearing, a nut on the shaft and adjustable against the spring whereby to effect a yielding application of force to the traction frame tending to rotate it on the lever in the plane of the legs.

6. A fracture reduction and immobilization splint comprising an anchor frame adapted for fixed connection with a well leg, a traction lever pivotally fixed in the anchor frame, a slide block slidable on the lever, means for pivotally securing the said block at different positions of adjustment along the lever, a traction frame mounted by the slide block, means for adjusting the lever to effect an application of tractive force to the traction frame to be sustained by the well leg through the anchor frame, a bearing on the lever and adapted to be sustained in set position and an adjusting means connecting the said bearing and slide block for adjusting the latter about its pivotal mounting on the lever, whereby to adjust the traction frame to swing the bone fragment inwardly or outwardly with reference to the axis of the limb.

7. A fracture reduction and immobilization splint comprising an anchor frame adapted for fixed connection with a well leg, a lever arm fixed on the anchor frame, a traction lever pivotally fixed in the anchor frame, a block slidable on the lever, means for pivotally securing the said block at different positions of adjustment along the lever, a traction frame mounted by the block, means connecting the lever arm and lever for adjusting the latter to effect an application of tractive force to the traction frame to be sustained by the well leg through the anchor frame, a bearing slidable on the lever and adapted to be sustained in set position by abutment with the block and an adjusting means connecting the said bearing and block for adjusting the latter about its pivotal mounting on the lever, whereby to adjust the traction frame to swing the bone fragment inwardly or outwardly with reference to the axis of the limb.

8. In a fracture reduction splint of the character described, an anchor frame adapted for fixed mounting on the well leg; a lever adjustably fixed to said frame and extended across the injured leg, a slide block adjustable to different positions along the lever, a bolt pivotally connecting the slide block with the lever at its position of adjustment to permit said block to rock on the lever in a plane parallel to the plane of the legs, means mounted on the lever and connected with the slide block to adjust and yieldingly retain the position of the latter relative to the lever, a yoke mounting block pivotally mounted on the slide block to pivot on an axis that is substantially parallel to the plane of the legs and perpendicular to the axis of the injured leg, releasable means interconnecting the slide block and yoke mounting block to retain their relative positions of adjustment, a yoke rotatably adjustable in the yoke mounting block, means on the yoke through which a skeletal connection may be made with the fractured bone at a point below the fracture.

9. In a fracture reduction splint of the character described, an anchor frame adapted for fixed mounting on the well leg; a lever adjustably fixed to said frame and extended across the injured leg, a slide block adjustable to different positions along the lever, a bolt pivotally connecting the slide block with the lever at its position of adjustment to permit said block to rock on the lever in a plane parallel to the plane of the legs, means mounted on the lever and connected with the slide block to adjust and yieldingly retain the position of the latter relative to the lever, a yoke mounting block pivotally mounted on the slide block to pivot on an axis that is substantially parallel to the plane of the legs and perpendicular to the axis of the injured leg, releasable means interconnecting the slide block and yoke mounting block to retain their relative positions of adjustment, a yoke rotatably adjustable in the yoke mounting block, means on the yoke through which a skeletal connection may be made with the fractured bone at a point below the fracture, means for rotatably adjusting the yoke to axially rotate the leg, and means for adjusting the position of the frame connecting lever to effect the application of a tractive force to the traction frame, sustained by the anchor frame.

10. In a splint, in combination, an arcuate yoke adapted to embrace the fractured leg, means carried by the yoke arms through which skeletal connection may be made with the leg, a yoke mounting block, manually operable means carried by the block for rotatably adjusting the yoke therein to axially rotate the leg, a slide block, means connecting the yoke mounting block and slide block to permit tilting the yoke in the longitudinal di-

rection of the leg, an arm extended from said yoke mounting block having an arcuate slot, a bolt extended through said slot and adapted to be tightened into the slide block thereby to hold the yoke mounting block in a set position, and a traction lever mounting said slide block.

11. In a fracture reduction splint, a traction yoke adapted to embrace the injured limb, a mounting block for the yoke, means for adjusting the yoke in the block, a pair of clamp bars on each of the yoke arms and extending perpendicularly to the plane of the yoke, and a transfixion pin extended across the yoke mouth and adapted to be held at its ends between the bars at any position within their lengths.

12. In a fracture reduction splint, an anchor frame, adapted to overlie the well leg, a traction frame adapted to overlie the injured leg, and a lever mechanism connecting the frames and adjustable to effect the application of a tractive force to the traction frame; said frames each including means for mounting paired transfixion pins for direct skeletal connection with the legs.

13. In a splint of the character described, a yoke mounting block, an arcuate traction yoke rotatably slidable therein, a shaft rotatable in the block and an adjusting cable fixed to the yoke and connected to the shaft in a manner whereby rotation of the shaft will wind the cable thereon to effect an adjustment of the yoke in its mounting block.

14. In a splint, a yoke mounting block, an arcuate traction yoke slidably mounted therein for adjustment about the axis of the yoke, a bearing block pivotally fixed to one end of the yoke, a bearing block pivotally fixed to the yoke mounting block and an adjusting shaft rotatably fixed in one of said bearing blocks and threaded through the other, and means for rotating the shaft thereby to effect an adjustment of the yoke relative to the mounting block.

15. A method of reducing fractures of the femur occurring in the inter-trochanteric and inter-cervical region which comprises applying traction to the distal fragment through the mediacy of direct skeletal attachment means, and mechanically maintaining the tractive forces in a direction whereby muscle connections will cause an inward pressure of the fragment at the fracture, whereby to maintain contact during the healing period.

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