

[54] SURGICAL TABLE

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[51] Int. Cl. **G01n 23/00**

[58] Field of Search **250/59, 56, 57, 58;**
128/84 R, 84 B, 71

[56]

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[57]

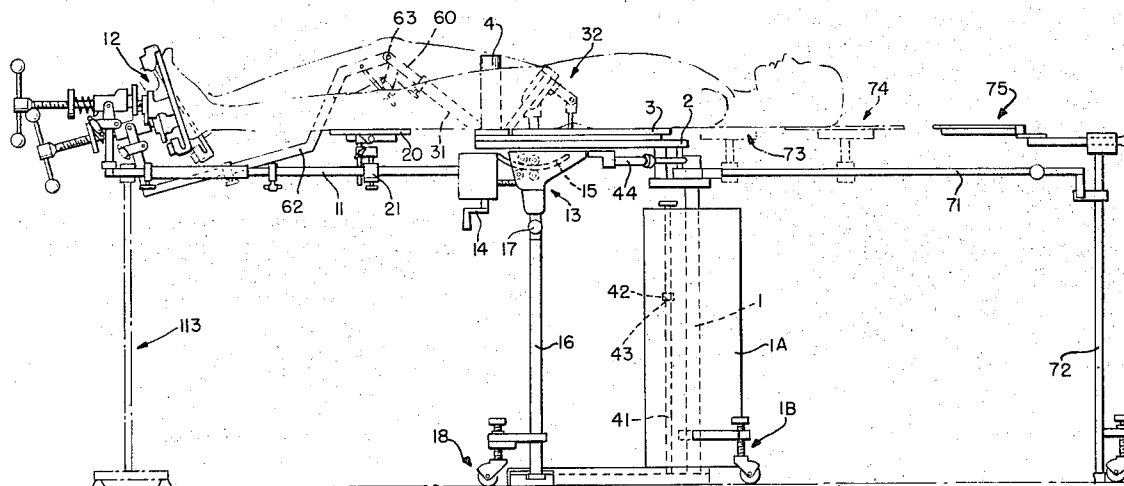
ABSTRACT

A multi-purpose surgical table and method of use is disclosed, the table having particular use in conjunction with a mobile X-ray image intensification unit. The table provides an open area free of obstructions for the image intensifier of the image intensification unit to be located beneath the patient, permitting lateral and anterior-posterior views of an injured extremity or trunk of the body without change of position of the patient from an initial supine position on the table,

without change in position of the table, and without change in the initial set position of the image intensification unit on the floor. The table has a sacral rest extending distally of a support pedestal. The sacral rest is substantially transparent to X-rays and free of any obstruction directly underneath. A perineal post substantially transparent to X-rays is mounted on the sacral rest. A leg support for the leg to be treated pivots vertically and horizontally about a pivot point coinciding with the anatomical axis of the hip joint of the injured leg. The leg support extends alongside the outer length of the leg at a sufficient height from the floor on which the table is resting to allow the image intensifier in its lowest position for anterior-posterior viewing and yet give sufficient clearance for the face of the image intensifier to be positioned closely adjacent or against the skin of the leg of the patient for both anterior-posterior and lateral viewing without movement of the patient or the table.

In addition to obtaining the two standard views of the hip, shaft of the thigh bone, bones of the knee, lower leg and ankle, the table has additional features which allow the two standard views (anterior-posterior and lateral) of the head, neck, spinal column, pelvis, shoulder joint and arm to be obtained without movement of the patient from an initial supine position and without movement of the table. The table, in addition, provides a unique non obstructing way of obtaining abduction, adduction and flexion-extension on anatomic centers at the shoulder of an injured arm or at the hip of the injured or well leg, and means of holding the legs in any degree of such movement. The table also provides a means of obtaining flexion-extension of the knee on its anatomic center. The table is also useful for diagnosis, reduction of fractures, vascular surgery and other techniques.

15 Claims, 17 Drawing Figures



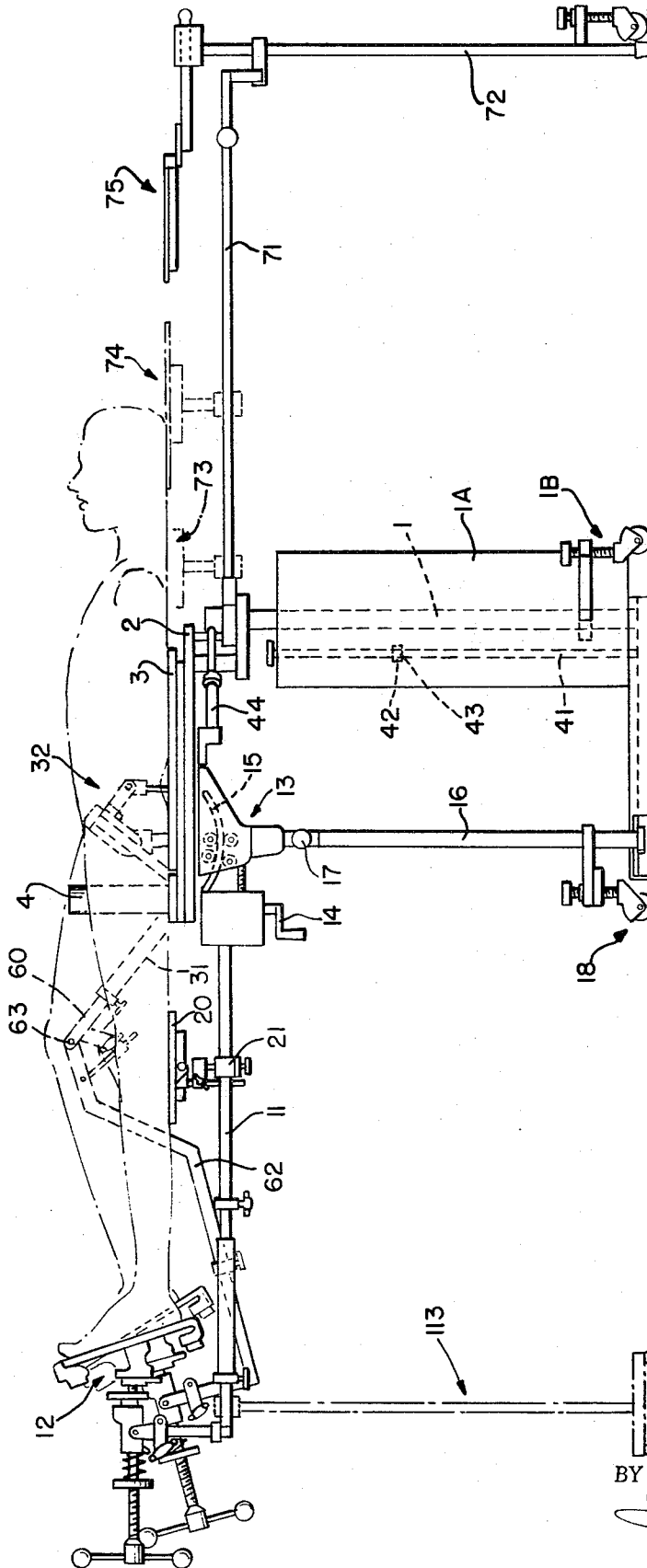
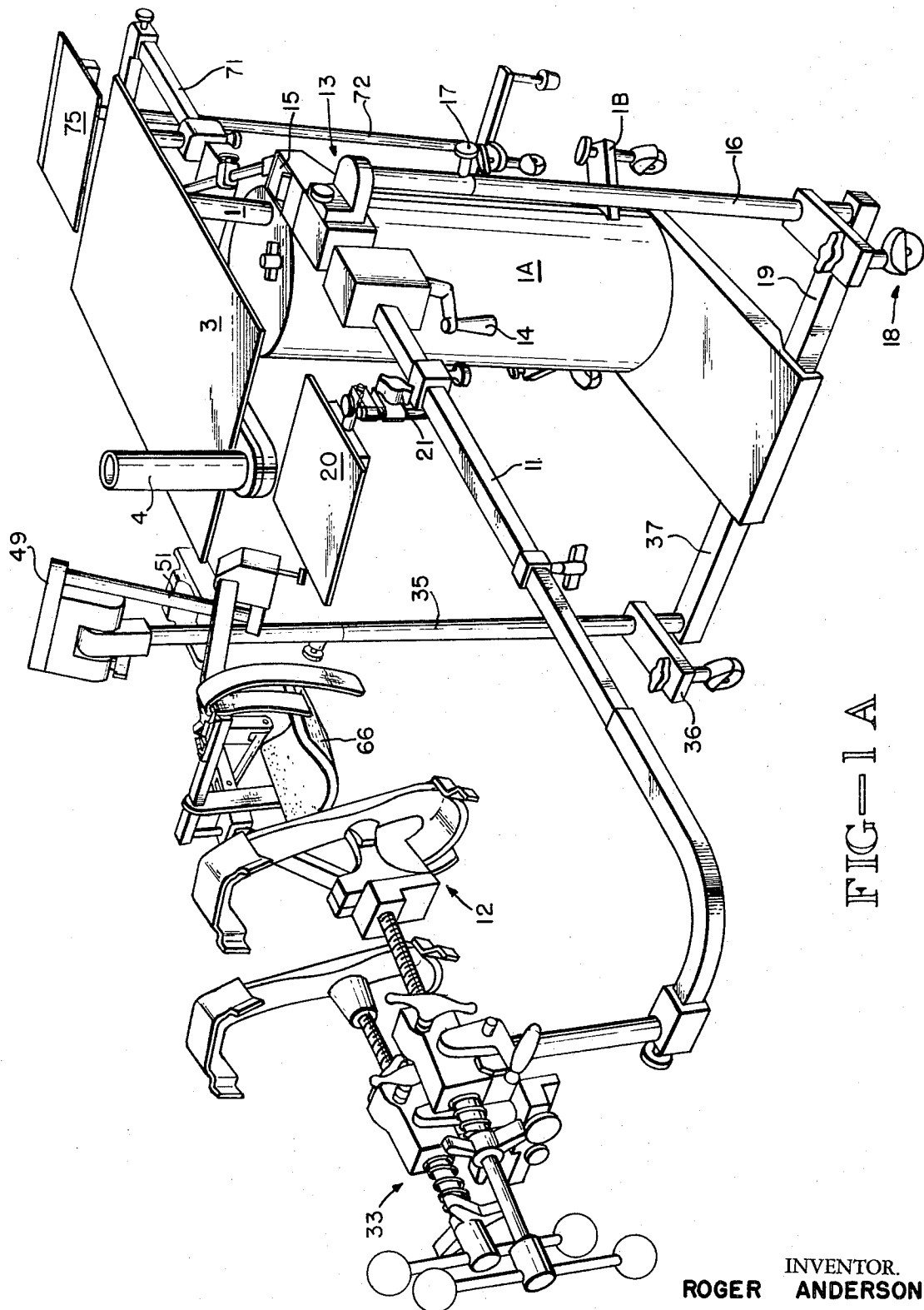


FIG-1

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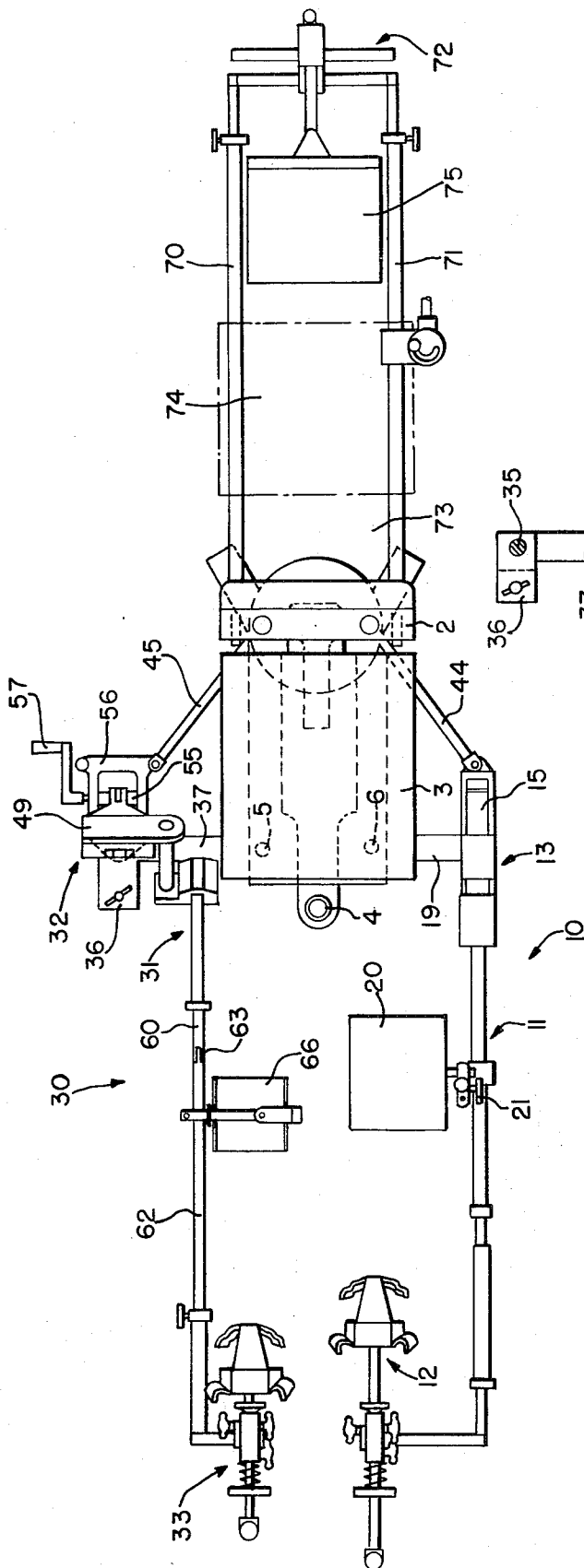


FIG-2

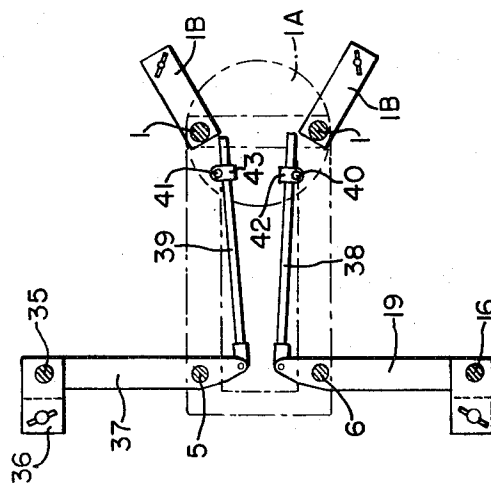


FIG-3

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FIG-4

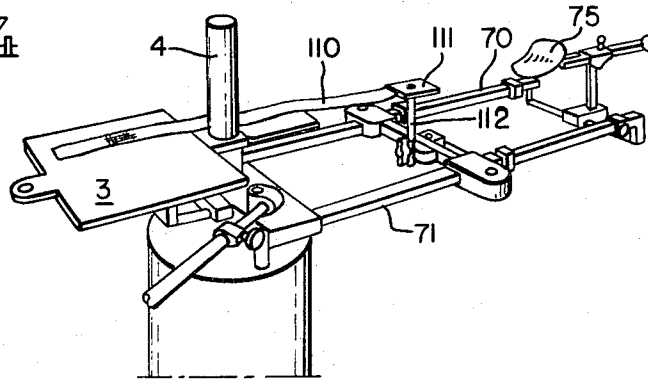


FIG-5

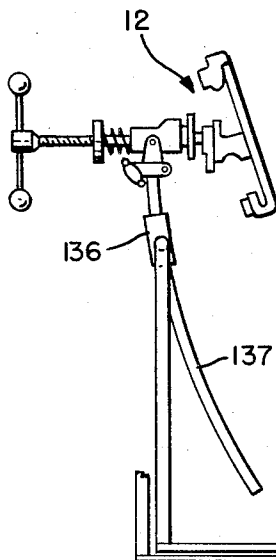
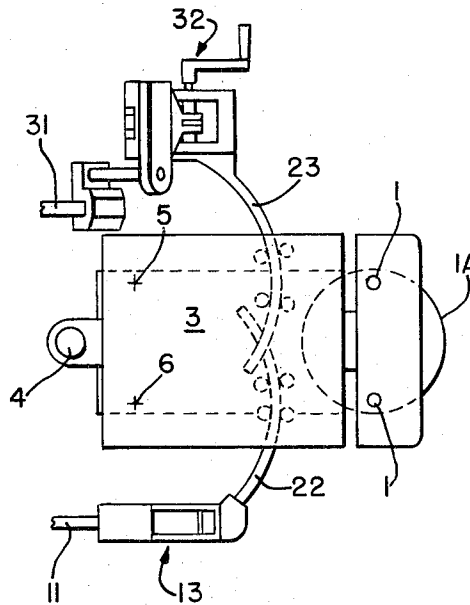
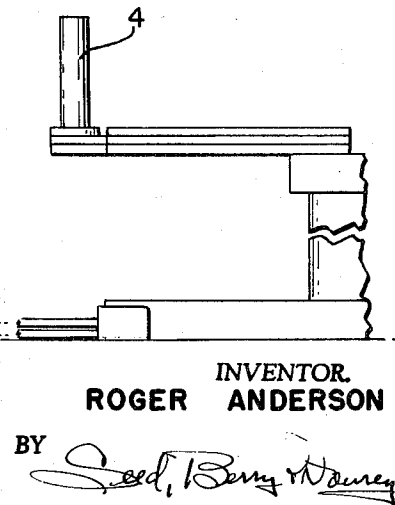


FIG-14



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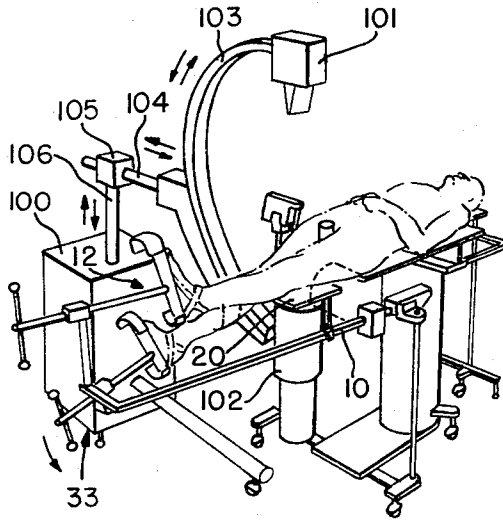


FIG-6

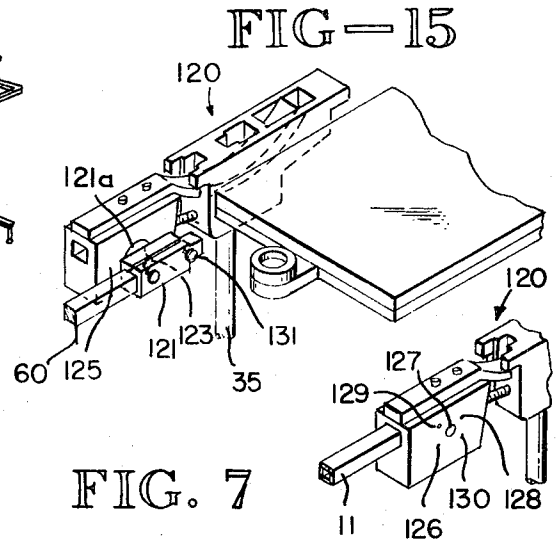


FIG. 7

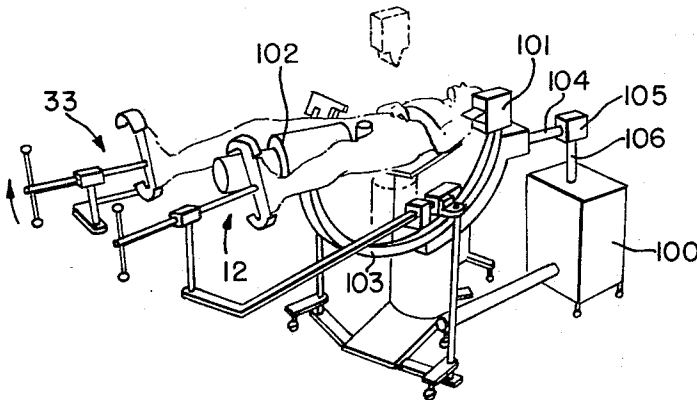
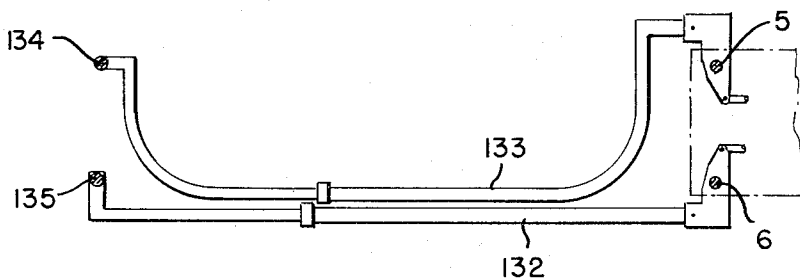
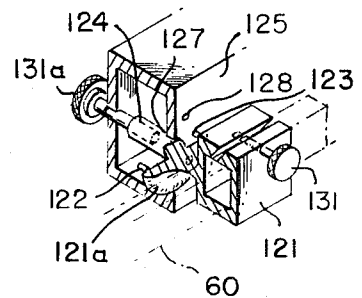
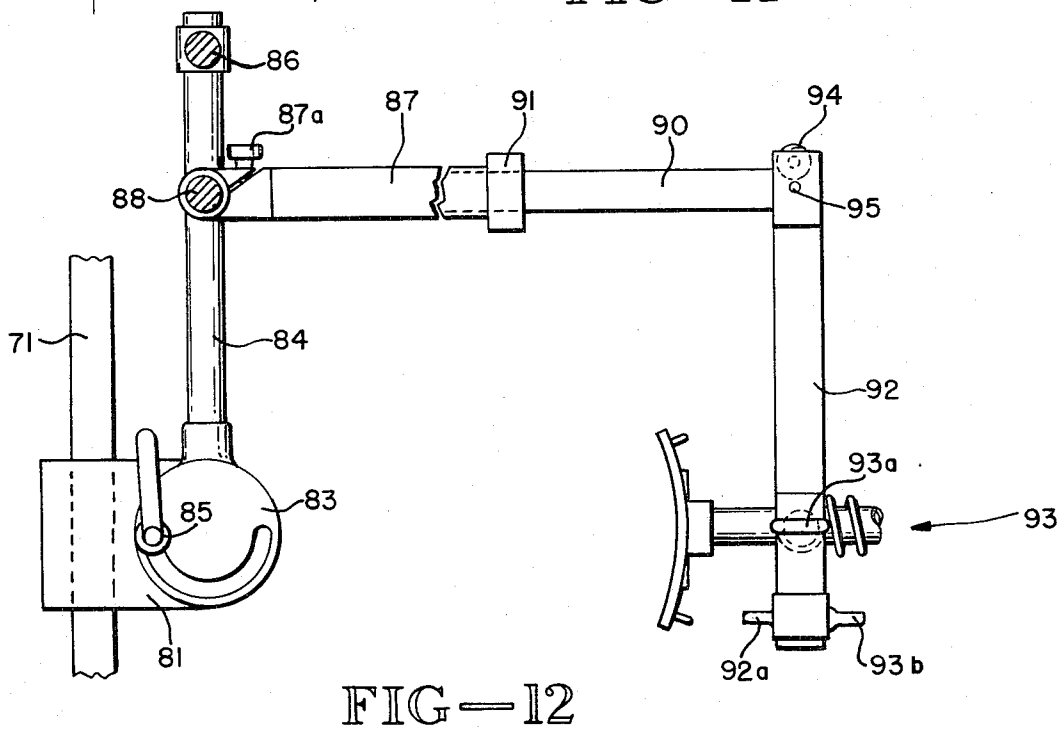
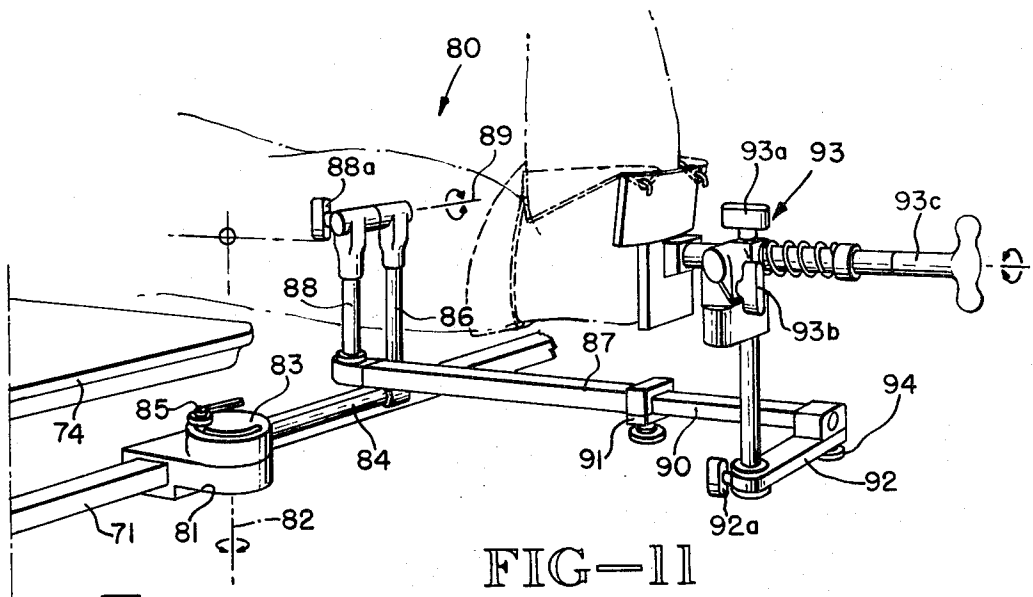


FIG. 13

FIG-15A



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SURGICAL TABLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a multi-purpose surgical and particularly an orthopedic table and method of using the table with a conventional mobile X-ray image intensification unit.

2. Prior Art Relating to the Disclosure

X-ray image intensification techniques are rapidly replacing the conventional fluoroscopic image due to the low brightness level of the conventional fluoroscopic image which forces the fluoroscopist to darken the room entirely or undergo dark application for a predetermined time so that details are discernible at the low light levels. Convention fluoroscopic techniques unnecessarily expose the patient and doctor to an extremely high radiation dose. Mobile X-ray image intensification units are manufactured by several companies including Siemens, North American Philips (Norelco) and others. These X-rays image intensification units are of the type shown in FIGS. 8 and 9 of the drawings and include an X-ray generating tube and image intensifier mounted on respective ends of a C-arc. The X-ray tube and image intensifier are movable from a vertical position to a horizontal position along the C-arc. Additionally the two units may be revolved about the axis of the frame holding the C-arc.

Orthopedic or extension tables which are presently available for use with mobile X-ray image intensification units have many disadvantages evident to the doctor or doctors participating in a surgical operation. They generally (1) require the patient to be placed in an unnatural position, (2) require the mobile image intensification unit to be located at a point where the doctor or doctors cannot have free access to the patient, (3) have obstructions in the form of supports, extensions, etc. which, during moving of the image intensification unit, are in the path of the image intensifier or X-ray generator, (4) require the patient to be moved from one position to another in order to get the two standard views generally necessary, the anterior-posterior and lateral views.

Prior patents relating to fracture or orthopedic tables having facilities for taking X-ray photographs of hips or bones in the pelvic region are U.S. Pat. No. 2,266,296 and U.S. Pat. No. 2,691,979. Fracture setting or orthopedic tables useful with X-ray fluoroscopy do not offer the advantages of a non-obstructing passage underneath the table to make it possible to utilize the full potential of image intensification techniques.

Many of the mobile image intensification units used in hospitals today are equipped with a television camera allowing use of X-ray television facilities in the operating room, which is of particular advantage to the surgeon. The X-ray image is depicted on a monitor screen which can be viewed by all operating personnel at the same time without special viewing systems. To obtain clear viewing it is necessary to position the image intensifier as closely to the injured portion of the patient to be treated as possible. The image intensifier equipped with a television camera is an expensive piece of equipment and it has been necessary, when present extension tables are used, to carefully avoid hitting the image intensifier and its associated facilities and camera against supports for the table to avoid damage thereto. This is particularly difficult during an opera-

tion as the table and surrounding area are generally covered with surgical drapes.

SUMMARY OF THE INVENTION

This invention relates to a multi-purpose table and method of using the table in conjunction with a mobile image intensification unit, the table enabling the doctor or one under his direction to obtain anterior-posterior and lateral views of the hip, shaft of the thigh bone, bones of the knee, lower leg and ankle, the head, neck, spinal column, pelvis, shoulder and the arm without moving the image intensification unit from an initial set position on the floor of the operating room, without moving the table, and without moving the patient from an initial supine position. The table provides a sacral rest on which is mounted a perineal post, both extending distally from a support pedestal free underneath of any obstruction for the image intensifier. Leg, body and arm supports are so arranged to permit placing of the intensifier unit underneath closely adjacent or up against the injured area of the patient to be treated without any obstructions. The table is capable of reducing fractures by mechanical means which operate upon anatomical center and axes. The image intensifier of the mobile image intensification unit can always be positioned on the underside of the patient as the table is free of all obstructions underneath. The leg and/or arm traction supports are placed high enough from the floor upon which the table rests for the image intensifier in its lowest position for anterior-posterior viewing to pass thereunder without contact. The supports are also so located as not to obstruct anterior-posterior or lateral viewing of the injured extremity along any portion thereof.

The objects of this invention are to provide a multi-purpose table having the following advantages: (1) the standard two X-ray views, that is the anterior-posterior view and the lateral view of the hip, shaft of the thigh bone, bones of the knee, lower leg and ankle, the head, neck, spinal column, pelvis, shoulder joint and arm can be accomplished without obstruction of the X-ray field, without movement of the mobile image intensification unit from an initial set position, without movement of the patient from an initial supine position and without movement of the table. (2) The image intensifier can be placed below and up against the skin or support of the injured limb or body of the patient without obstruction of the X-ray field. (3) Fractures can be reduced by mechanical means which operate upon anatomical centers and axes, the mechanical means being non-obstructive to placement of the image intensifier of an image intensification unit. (4) The table reliably supports the extremities, head, neck and/or trunk of a patient. (5) The mobile image intensification unit can be placed opposite the surgeon and used to obtain X-ray views without obstruction of the X-ray field and without interference with the work of the surgeon. (6) Obstructions to an image intensification unit below the leg traction supports and hip area are eliminated permitting the image intensifier to be positioned at any point along the leg or positioned between the legs of the patient to view the hip joint. (7) Obstructions to an image intensification unit below the arm traction support are eliminated permitting the image intensifier to be positioned at any point along the arm or at the shoulder joint to obtain the two standard views of the arm or shoulder joint. (8) Abduction-adduction and flexion-

extension on anatomical centers of the hip of the injured leg or the joint of the injured shoulder can be obtained without obstruction. (9) Flexion-extension on the anatomical center of the knee can be obtained. (10) Reversible hip units for the injured leg or leg to be treated and the well leg, are provided, the well leg hip unit providing a greater range of vertical motion.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of the table showing the patient in a supine position with the left and right legs of the patient under traction;

FIG. 1A is a perspective view of the table of FIG. 1;

FIG. 2 is a plan view of the table of FIG. 1;

FIG. 3 is a partial cross section of one means of attaching the leg traction supports to the central supporting pedestal of the table for anatomical movement around pivot points coinciding with the hip joints of a patient lying on the table in a supine position;

FIG. 4 is a partial perspective view of the table of FIG. 1 wherein the perineal post has been moved to a second position and wherein the patient is supported by a relatively small "island" member and a head cup leaving the area beneath the main trunk of the patient free for application of a body or spica cast;

FIG. 5 is a partial plan view of the table of FIG. 1 showing a modified means of connecting the leg traction supports to the central supporting pedestal of the table for movement about the anatomical centers of the hip of the patient lying on the table in a supine position;

FIG. 6 is a perspective view of the table of FIG. 1 in conjunction with a mobile image intensification unit, the image intensifier positioned beneath the patient and up against a support for the injured leg of the patient for X-ray viewing; the image intensification unit shown in solid lines for anterior-posterior viewing and in dotted lines for lateral viewing;

FIG. 7 is a perspective view of the table of FIG. 1 with the patient on the table in a supine position and the mobile image intensification unit positioned for lateral viewing of the hip joint (in solid lines) and anterior-posterior viewing of the hip joint (in dotted lines);

FIG. 8 is a partial perspective view of a hip arc unit obtaining anatomic flexion-extension of the hip of the well leg;

FIG. 9 is a partial front view of FIG. 8 illustrating the means by which the hip arc unit can be interchanged and used with either the left or right leg;

FIG. 10 is a side view of the leg traction support for the well leg of the patient and showing a novel flexion-extension means for the knee of the patient along the anatomic center of the knee;

FIG. 11 is a partial perspective view illustrating a non-obstructing method for obtaining both lateral and vertical viewing of the shoulder joint, upper arm or forearm of a patient;

FIG. 12 is a plan view of the arm traction support of FIG. 11.

FIG. 13 illustrates a modified way of running the leg traction tubes closely adjacent the floor on which the table is resting to the leg pulling means;

FIG. 14 illustrates a further modification using leg pulling means mounted on the upper end of an arc for vertical movement about a pivot point substantially coincident with the anatomical axis of the hip joint of the patient; and

FIG. 15 illustrates modified hip arc units allowing vertical movement about pivot points substantially coincident with the anatomical axes of the hip joints of the patient; and

FIG. 15 A is a partial cross-section view of the left side of FIG. 15.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1 the table of this invention comprises central posts 1 surrounded by cover 1A. Although the cover is shown as being round it may be made rectangular or other suitable shape which is non-obstructing. The posts are supported from the floor by conventional casters 1B of the type generally used on surgical tables. On the top of the posts is rigidly mounted a T-shaped plate 2. A pelvic table top 3 made of a material such as Bakelite or other material which is substantially transparent to X-rays is secured to the plate 2 and extends distally a predetermined distance generally about 22 inches and is free of any obstruction underneath. A perineal post 4, preferably a hollow tubular post of aluminum or other material transparent to X-rays, is positioned at the distal end of the sacral rest 3.

LEG TRACTION SUPPORT ASSEMBLY FOR THE INJURED LEG

Leg traction support assemblies for both the injured leg and the well leg are mounted for horizontal movement about points substantially coincident with the anatomical axes of the hip joints of the patient lying supine on the table as shown in FIG. 1. The leg traction support assemblies are, in parallel position, preferably spaced a predetermined distance apart, the distance preferred related to the radius of the C-arc on which the image intensifier and X-ray generator are mounted. In FIG. 2 and FIG. 3 pivot points 5 and 6 are positioned a proximal distance of about four inches from the perineal post and a mesial distance of about four inches from the perineal post. These pivot points closely represent the anatomical centers of the hip joints of the average person. The injured leg traction support assembly 10 is shown on the right in FIG. 2. The leg traction support assembly 10 includes a traction rod 11, adjustable in length, secured at its upper end to a hip arc unit 13. To the lower or distal end of the traction tube 11 is positioned a footplate assembly 12. The footplate assembly 12 forms no part of this invention. Reference may be made to U.S. Pat. No. 3, 135,257 for a complete description thereof. The footplate of the footplate assembly is mounted for rotation and horizontal and/or vertical pivot about a point in line with the hip joint of the patient laying in a supine position on the table. With the foot of a patient strapped to the footplate tension can be provided in a line coinciding with the anatomical axis of the tibia and/or femur of a patient. The rod 11 for the injured leg extends along the outer length of the leg a sufficient distance from the floor on which the table is resting so that the image intensifier in its lowest position for anterior-posterior viewing can pass thereunder without obstruction. The rod is also placed beyond the side of the leg and beneath the mid-line of the leg so that the image intensifier can be brought up beneath the leg at any point and into contact with the skin of the leg of the patient (or a support therefor) for anterior-posterior viewing or be brought up against the side of the leg for lateral viewing. Traction rod 11 is at-

tached at its upper end to hip arc unit 13 which, on turning of handle 14, pivots the rod and leg of the patient vertically about a pivot point substantially coincident with the anatomical axis of the hip joint of the injured leg. As can be seen in FIG. 1 and FIG. 2 the arc unit 13 is relatively narrow along a transverse axis and is smooth on each side and along the top so that the face of the image intensifier can be brought up in the limited space between the hip arc unit 13 and supporting pedestal 1 and its associated cover 1A. The arc 15 of the hip arc unit should have a sufficient radius not to protrude above the top surface of the table when the traction rod is lowered but not so large a radius as to prevent passage of the image intensifier beneath the hip of a patient laying on the table. Handle 14 may be located directly as shown in FIG. 1 with placement of the image intensifier up against the thigh. The injured leg of the patient positioned as shown in FIG. 1 can be raised or lowered along with the traction rod as desired by turning handle 14. The arc unit 13 and rod 11 are removably clamped onto a vertical tubular support 16 by clamping means 17. The tubular support is in substantial vertical alignment with the pivot point 6. The lower end of tubular support 16 is supported on the floor by a conventional caster assembly 18 of the type generally used for surgical tables, the caster being of the type which can be locked in a fixed position when desired. The tubular support 16 and leg traction assembly 10 connected thereto are made to pivot about pivot point 6 by securing the tubular support 16 and leg traction assembly 10 associated therewith to a laterally extending connecting arm 19 attached between the tubular support at the lower end thereof and pivot point 6. It is important that the connecting arm 19 be located at a height from the floor on which the table is resting so that the image intensifier in its lowest position for anterior-posterior viewing can pass thereover without contact. The distance between pivot point 6 and tubular support 16 or the length of connecting arm 19 should be sufficient to allow clear access for the image intensifier between the tubular support 16 and the cover 1A of the central pedestal 1. Free access to this area without any obstruction allows the image intensifier to be positioned directly beneath the hip joint of a person lying in a supine position on the table.

Leg supports 20 of Bakelite or other material substantially transparent to X-rays may be clamped by clamping means 21 to traction rod 11 to aid in supporting the injured leg of the patient.

LEG TRACTION SUPPORT ASSEMBLY FOR THE WELL LEG

One form of leg traction support assembly 30 for the well leg is shown in FIG. 2 on the left side of the table as viewed from the distal end thereof. The support assembly illustrated pivots horizontally about pivot point 5 in the same way as the leg traction support assembly 10 for the injured leg.

The traction rod for the well leg assembly is located closer to the mid-line of the table and leg of the patient to prevent obstruction of the image intensifier and the C-arc on which it is mounted. A greater range of horizontal and vertical motion is needed with the well leg traction support assembly than with the injured leg traction support assembly. A hip arc unit such as used with the injured leg assembly may be used with the well leg assembly with some modification. The well leg must

have a greater range of movement than the injured leg as will be explained. The hip unit 32 shown in FIGS. 1 and 2 has the center of flexion of the hip located laterally of the hip joint and in the same horizontal plane as the hip joint. Increased vertical and horizontal movement about a pivot point substantially coincident with the hip joint of the patient laying in a supine position on the table is thus possible. The well leg can be raised vertically to substantially a right angle position or lowered until the heel bone of the patient touches the floor on which the table is resting. Traction rod 31, adjustable in length, is secured at its proximal or upper end to the hip unit 32 which is capable of pivoting the rod 31 and the footplate assembly 33 vertically about a pivot point 34 (see FIG. 8) substantially coincident with the anatomical center of the hip joint of the patient laying in a supine position on the table. The footplate of the footplate assembly is mounted for rotation and horizontal and/or vertical pivot about a point in line with the hip joint of the well leg. The hip unit 32 is removably supported on a vertical support 35 provided with casters 36 at its lower end. The vertical support 35 pivots about pivot point 5 and is attached thereto by a lateral connecting arm 37 as shown in FIG. 3. The distance between pivot point 5 and vertical support 35 is the same as the distance between pivot point 6 and vertical support 16. The distance between the two pivot points and the vertical support is maintained the same in order that the leg traction support assemblies may be interchanged. For example, referring to FIG. 2, the leg traction support assembly 10 for the injured leg shown on the right as viewed from the distal end of the table can be removed from its vertical support 16 and transferred to the left side for treating the left leg of the patient. Similarly the well leg traction support assembly 30 shown on the left in FIG. 2 can be unclamped from its vertical support 35 and transferred to the right side.

Referring to FIG. 3 the inner ends of connecting arms 19 and 37 are pivotally connected to rods 38 and 29 which extend at their opposite ends through clamping means 40 and 41. The clamping means are actuated by turning rods 42 and 43 (see FIG. 1) which extend upward as shown in FIG. 1 to a point just below the top of the table and are provided with a knob on the top end thereof. The surgeon or person under his direction may, therefore, move either of the leg traction support assemblies laterally outwardly or inwardly about pivot points 5 and 6 and lock or clamp them in position by tightening clamping means 40 and 41 on turning of rods 42 and 43.

Additional support for the leg traction assemblies may be provided at their upper ends by telescoping members 44 and 45 pivotally attached at one end to the proximal or upper ends of the respective leg traction support assemblies and pivotally attached to the central post 1 at their opposite ends as shown in FIG. 2.

Referring to FIGS. 8 to 10 the support rod 47 for hip unit 32 is removably clamped by clamping means 46 to the upper end of vertical support 35. Yoke 48 is pivotally mounted atop rod 47 for vertical movement about pivot point 34 which is substantially coincident with the anatomical center or axis of the hip joint of the well leg of the patient. A linking arm 49 is pivotally mounted on the upper surface of yoke 48 for pivot about pivot pin 50. Tubular member 51 connects with linking arm 52 which is pivotally mounted to the distal or upper end

of traction rod 31 for pivot around pivot pin 53. A threaded spindle 54 is pivotally secured at its upper end to the rear side of yoke 48 and extends through a block 55 having an internal worm gear in mesh with the threaded spindle, the block pivotally mounted to frame 56 rigidly secured to support rod 47. Turning of handle 57 effects vertical movement of traction rod 31.

As mentioned in connection with the injured leg traction support assembly, the well leg traction support assembly may be transferred to the opposite side of the table. The hip unit 32 is reversible as shown by dotted lines in FIG. 9. To reverse the hip unit 32 screw 58 extending through yoke 48 into linking arm 49 is loosened and the linking arm pivoted about pin 50, thereby placing the traction rod mounting on the opposite side as shown in dotted lines in FIG. 9. Screw 58 is then tightened. Similarly screw 59 extending through linking arm 52 into the upper end of traction rod 31 is loosened and pivoted 180° around pivot point 53. The traction assembly is then in position for use with the left leg (referring to FIG. 2) of the patient.

The well leg traction support assembly 30 also provides a means of flexion-extension of the knee of the patient on the anatomic center thereof. This feature is useful when the patient being treated suffers from arthritis or other conditions which stiffen the knees and/or hip in flexion. A calf support rather than the footplate assembly acts as a base for counter-traction, removing strain from the knee and/or hip joint.

Means for obtaining flexion-extension of the knee of the patient on its anatomic center is shown in detail in FIG. 10. Into the traction rod 31 is telescopically and adjustably mounted rod 60 clamped in place by clamping means 61. Pivotally attached to the distal end of rod 60 is rod 62 bent as shown in FIG. 10. To the distal end of rod 62 is clamped a footplate assembly of the same type as described previously for the injured leg, the footplate assembly mounted so that the spindle or pivot point thereof is in line with the anatomical axis of the hip joint of the patient laying in a supine position on the table. The footplate assembly is referred to generally as reference numeral 33. The rod extending at right angles from the footplate assembly 33 is telescopically mounted over rod 62 to adjust the length of the leg of the patient. Rod 60 can be extended or retracted as necessary to adjust the length thereof to the length of the thigh of the patient. Rod 60 keeps relatively close to the long axis of the leg and is adjusted in length until the pivot point 63 coincides with the anatomic center of the knee of a patient in supine position on the table with the foot of the patient strapped to the footplate assembly 33. Rod 62 can be held in a fixed pivoted position by clamping means 64. Clamping rod 65 is pivotally attached at one end to rod 62. A calf support 66, shown in FIG. 1, is secured to rod 62 to support the calf of the leg of the patient and act as a base for countertraction, thereby removing strain from the knee and/or hip of the patient.

An alternate means of mounting the well and injured leg traction support assemblies is shown in FIG. 5. Each of the support assemblies is attached to structurally strong arcs 22 and 23 which swing in respective arcs about pivot points 5 and 6 coinciding substantially with the anatomical centers or axes of the hip joints of the patient laying supine on the table. The advantage in mounting the support assemblies in this manner is that it clears all obstructions from beneath the table.

Modified hip arc units 120 (see FIGS. 15 and 15 A) may be used for both the well and injured leg traction support assemblies. The arc units have the same dimensions as arc unit 13. Since the well leg traction support assembly generally must be capable of greater movement in a vertical plane the upper end of the traction rod 60 is removably and slidably attached through sleeve 121. Sleeve 121 is secured to spindle 121 A which has pins 122, 123 and an internally threaded hollow nut 124 protruding from the vertical side face thereof which mate with holes bored in the inside horizontal face 125 of the arc units. The sleeve 121 may be secured to the inside face 125 of the arc unit in two or more positions. If the well leg is to be directed toward the floor as shown in FIG. 6 the sleeve 121 and traction tube are mounted as shown in solid lines in FIG. 15 with pins 122 and 123 secured in holes 126 and 128 and nut 124 extending into hole 127. If the well leg is to be raised to a position higher than that shown in FIG. 1 the sleeve 121 and traction rod are rotated upwardly to mate pins 122 and 123 with holes 129 and 130 in the arc unit. Threaded screw clamps 131 or other suitable means are used to clamp rod 60 in sleeve 121. The integral spindle and sleeve 121a and 121 are secured by threaded screw 131a. The traction rod 60 of the well leg assembly is positioned inwardly toward the mid-line of the table the same distance indicated by FIG. 2, i.e. about 2 inches.

To transfer the well leg traction support assembly to the opposite side of the table, traction rod 60 is removed. Screw 131a is loosened until pins 122 and 123 are free. Sleeve 121 and integral spindle 121a are transferred and clamped to the inner horizontal face of the opposite arc unit. Traction rod 11 is removed and inserted into sleeve 121 of the opposite arc unit.

Traction is generally the primary step taken in reduction of fractures. Traction efficiency depends directly on the degree and character of countertraction. Then traction is applied to the injured leg by the leg traction support assembly 10 an equal amount of countertraction should be applied to the opposite well leg through the leg traction support assembly 30. The leg traction support assemblies, referred to generally by reference numerals 10 and 30, provide a unique non-obstructing way of obtaining abduction-adduction and flexion-extension on anatomic centers at the hip of the injured and well legs and means of holding the leg in any degree of such movement. Further, the leg traction support assembly 30 provides a means of flexion-extension of the knee on its anatomic center.

Alternate means of providing a non-obstructing way of obtaining abduction-adduction and flexion-extension on anatomic centers at the hip of the injured leg and also means of providing such movement with the well leg are illustrated in FIGS. 13 and 14. In FIG. 13 traction rods 132 and 133 for both the well and injured legs extend distally from pivot points 5 and 6. The traction rods are positioned at a height from the floor on which the table is resting so that there is no danger of contact with the lower surface of the image intensifier when in its lowest position for anterior-posterior viewing. The traction rod 133 extends distally a short distance from pivot 5 and then curves inwardly toward the mid-line of the table and then extends distally substantially parallel to the traction rod 132. Both traction rods 132 and 133 are adjustable in length. Vertical posts 134 and 135 are mounted to the distal ends of

traction rods 132 and 133 at points in line with pivot points 5 and 6 which are substantially coincident with the axes of the hip joints of the patient. On the upper ends of posts 134 and 135 are mounted sleeves 136 thru which are extended arcs 137 secured to footplate assemblies 12 (see FIG. 14). The footplate assemblies are thus movable in a vertical plane about pivot points substantially coincident with the axes of the hip joints of the patient. Alternately, as shown in FIG. 14 the distal ends of traction rods 11 and 62 may be secured to sleeve 136 through which arcs 137 are extended, the arcs having mounted on the upper end thereof footplate assemblies 12 and 33.

UPPER OR PROXIMAL PART OF THE ORTHOPEDIC TABLE

Extending proximally from the central posts 1 (see FIG. 2) are parallel support rods 70 and 71, adjustable in length and supported at their upper ends, if necessary, by stanchion 72 provided with casters. The support rods are spaced far enough apart to allow an image intensifier to be brought up beneath the table and between the support rods in direct contact with the skin of the patient or with the underside of a body support which is substantially transparent to X-rays. As shown by dotted lines in FIG. 1 and in FIG. 2 top sections 73 and 74 of Bakelite or other material substantially transparent to X-rays are provided as needed to adequately support the body and head of the patient. These sections are made to be removed laterally so that the patient need not be disturbed. A head rest 75 may be provided and removably attached to the stanchion 72 as shown in FIG. 1 and FIG. 2. The upper or proximal portion of the table, that is the portion having the parallel rods 70 and 71, is primarily for viewing diagnosing and casting of the body from the top of the head to the crotch (symphysis pubis) and for viewing, diagnosing and casting of the arms through an arm traction assembly to be described. A tubular neck support (not shown) may be used to hold the neck in hyperextension for lateral viewing thereof to demonstrate to the surgeon viewing an operation to remove or fuse an injured vertebra, which disc to remove or which vertebra to fuse. The dual support rods 70 and 71 are located sufficiently beneath the mid-line of the body of the patient to allow clear lateral viewing of the trunk, neck and head of the patient laying in a supine position on the table as shown in FIG. 1. The rods are also placed a vertical distance from the floor on which the table is resting sufficient to allow the image intensifier in its lowest position for anterior-posterior viewing to pass thereunder. During the dangerous maneuvers of restoring realignment of a broken neck it is essential that the surgeon have clear viewing of that portion on which he is working. Therefore, for clear lateral or viewing it is necessary that the image intensifier be as close up against the body as possible to obtain clear focusing and clear vision either by television or ocular means.

ARM TRACTION SUPPORT ASSEMBLY

The arm traction support assembly 80 is shown in detail in FIGS. 11 and 12. A mounting block 81 is attached to one of the support rods 70 or 71 depending on which side the arm traction support assembly is to be mounted. Attached thereto for rotation about pivot point 82 in a horizontal plane is a rotatable member 83 from which rod 84 extends. The rod and rotatable

member are held in a predetermined position by clamping means 85. The pivot point 82 is located so that it will be coincident with the anatomical axis of the shoulder joint of a patient laying in a supine position on the table. Rod 84, to the end of which is secured rod 86, supports the arm traction rod 87 through rod 88. The traction rod 87 is releasably clamped to rod 88 by clamp 87a and pivots about pivot point 89 which coincides substantially with the anatomical center of the shoulder joint of a patient laying in a supine position on the table. Rod 88 can be clamped in a desired position by clamp 88a. Telescoping into traction rod 87 is an extension rod 90 clamped by clamping means 91 for adjustment of the length thereof. A right angle reversing link 92 is releasably secured to the outer end of extension rod 90 and is clamped to a vertical rod mounting an arm traction unit 93 by clamp 92a. The spindle and pivot point of the arm traction unit are in direct alignment with the anatomical centers of the shoulder joint of the patient and are capable of rotation, vertical or horizontal movement about the pivot point. Clamps 93a, 93b and 93c control movement of the traction unit 93 about its spindle and pivot point. The arm traction support assembly shown in FIG. 11 is shown for use with the left arm of the patient laying on the table as shown in FIG. 2. The arm traction support assembly can be detached from block 81 and moved to the opposite side for use with the right arm. When this is done screw 94 is loosened from its attachment to extension rod 90 and pivoted about pin 95 to effect correct alignment of the arm traction unit 93. The arm extension rod 90 and traction rod 87 are positioned a distance to the side of the arm of the patient and a sufficient vertical distance from the floor to allow the image intensifier to be brought up beneath the arm into contact with the skin of the arm or substantially so without obstruction. Lateral viewing of the arm or shoulder joint is easily obtained without obstruction of any kind as the arm traction rod and extension rod are below the mid-line of the arm.

MODE OF OPERATION

The table of this invention has particular utility in conjunction with a mobile image intensification unit shown generally in FIG. 6 and 7. A typical image intensification unit includes a housing 100 for the electronics of the unit, the housing mounted on suitable casters for easy movement. The X-ray generator 101 and image intensifier 102 are mounted on respective ends of a C-arc 103. The C-arc 103 is slidably mounted to one end of horizontal carrying arm 104 for travel along an arciform path. The horizontal carrying arm is mounted for horizontal movement in housing 105 which is supported by an adjustable vertical supporting column 106. The X-ray generator and image intensifier mounted on the respective ends of the curved C-arc, can be turned through 90° along the curved track. The C-arc 103 can be turned through 180° about the horizontal carrying arm 104 and the vertical column 106 supporting the whole unit can be adjusted vertically by suitable power means, or manually. The distance between the respective centers of the traction rods of the injured and well leg traction support assemblies, when they are positioned substantially parallel to one another, is preferably less than the radius of the C-arc, thereby allowing full range of use of the image intensifier without contacting the C-arc 103 against the trac-

tion tube of the well leg assembly. In practice the well leg of the patient strapped to the well leg support assembly is lowered and swung inwardly (medially) about its hip joint so that the foot of the well leg is almost under the foot of the injured leg. The degree of traction is not affected as movement of the traction assembly is along anatomic centers.

In using the table of this invention it is preferable that the image intensifier be kept beneath the body of the patient. The image intensifier, as noted from the drawings, is considerably larger in size than the X-ray generator. By keeping it underneath the patient at all times the surgeon has more freedom of movement than if obstructed by the image intensifier. Further, it is desirable, in order to obtain clear viewing of the particular portion of the body to be treated, that the image intensifier be as close to the skin of the patient as possible. If the image intensifier were above the patient it would be impractical and would hinder the surgeon if the image intensifier were brought down substantially against the skin of the patient. There is also greater danger of contamination and infection if the image intensifier is located directly above the area where the surgeon is working.

FIG. 6 shows the use of the table in obtaining the two standard views of the thigh of an injured leg. The mode of operation in general comprises placing a patient with the buttocks on the sacral rest with the crotch of the patient disposed about the perineal post or other means of counter traction. Referring to FIG. 6 the left leg of the patient is the injured leg. The traction rod 11 of the injured leg traction support assembly 10 is adjusted to fit the length of the leg of the patient and the foot of the patient strapped to the foot plate assembly 12. The traction rod of the well leg traction support assembly 30 is adjusted to the length of the right leg of the patient and the right foot strapped to the right foot plate assembly 33. If needed a support plate 20 for the injured leg may be placed under the leg of the patient. The desired traction is then placed along the anatomical axes of the left leg of the patient. An equal amount of countertraction is also placed on the right or well leg. The image intensifier is preferably positioned opposite the injured leg and moved under the injured leg by lowering the vertical support column 106 to its lowest position. The right or well leg of the patient is then dropped beneath the level of the left or injured leg and swung inwardly a sufficient distance to allow clear lateral viewing of the injured leg. The image intensifier of the image intensification unit can be brought up beneath the injured leg without obstruction and positioned directly beneath the injured portion of the left leg, either against the skin of the patient or a support 20. The surgeon standing on the side of the table adjacent the injured leg has free, unimpeded movement and access to the injured leg. Should the surgeon desire a lateral view of the injured leg the intensifier is lowered to its lowest position by lowering the vertical support column 106. Then the horizontal carrying arm 104 is extended sufficiently for the image intensifier to pass under the traction rod 11. The X-ray generator and image intensifier are then rotated 90° about their axis to the position shown by the dotted lines in FIG. 6. The horizontal carrying arm 104 is retracted to bring the image intensifier directly up against the skin of the leg of the patient for clear lateral viewing. The left or well leg is dropped sufficiently so that the central beam of

the X-ray generator has an unimpeded path through the center of the injured leg. Both lateral and vertical viewing are accomplished without movement of the patient, without movement of the mobile image intensification unit from an initial set position on the floor of the operating room and without movement of the table.

FIG. 7 shows the mode of operation for anterior-posterior and lateral viewing of the hip joint of a patient. The image intensification unit is placed so that access by the surgeon to the injured hip is completely free of any obstruction for both lateral and anterior-posterior viewing. The well leg traction support assembly 30 is pivoted laterally about pivot point 5 to spread the legs of the patient sufficiently to allow the image intensifier to be brought between the legs for lateral viewing of the hip joint. If necessary the well leg can be flexed at the hip and knee over the intensifier without changing the degree of traction. For vertical viewing the X-ray generator and image intensifier are rotated 90° to the position shown by the dotted lines in FIG. 7. After surgery or reduction of the fracture the surgeon may apply a leg or spica cast without movement of the patient and without obstruction.

For diagnosing, viewing and casting of the trunk of the patient the perineal post is moved approximately 22 inches in a proximal direction as shown in FIG. 4. Although the body supports 73 and 74 are not shown in FIG. 4 these can be provided to assist in supporting the body of the patient. After the injured portion of the trunk has been determined and diagnosed and surgery completed, if needed, the support plates are removed laterally without movement of the patient and replaced by an "island" support plate 111 which is removably secured to vertical support 112. A pull out strap 110 is attached to plate 111. This leaves the entire under portion of the body of the patient free for application of a body cast. After the cast is applied the strap is pulled at the distal end to remove the strap and plate 111.

The arm traction support assembly is utilized as shown in FIG. 11 for viewing diagnosing, and reduction of fractures of the forearm, the upper arm or shoulder joint. Casts can be applied to the arm or shoulder joint and, if desired, joined to a body cast without encountering any obstructions.

Referring to FIG. 1, a support stanchion 113 may be used to support the outer extremity of the leg traction support assembly 10 or support 20, particularly if heavy pressure is used by the surgeon for drilling, screwing on plates, grafting or chiseling bone. The support stanchion assists in stabilizing the leg traction support assembly supported in mid-air at the proximal end thereof. A support stanchion may also be used for the arm traction support assembly.

The structural features of this table makes it possible to accomplish the following:

1. The legs and arms are supported in mid-air to freely permit placement of the image intensifier underneath the arm or leg to be viewed.
2. The pivot points 5 and 6 for the leg traction support assemblies are restricted in height to permit safe placing of the image intensifier over the hip center for X-rays of the hip and trochanters without danger of contact and damage thereto.
3. The support tops for the table and the perineal post extend proximally and distally into the air, respectively, free underneath of any obstruction, thereby allowing the image intensifier to be brought up directly

beneath the extremity or body of the patient to be treated.

4. Structural means are provided for keeping the underside of the table free of any and all obstructions which could potentially damage an image intensifier positioned thereunder. The leg traction rods of the injured leg or arm are placed high enough for the image intensifier to pass thereunder and yet placed beneath the leg of the patient sufficiently to give clearance for both anterior-posterior and lateral viewing. Mechanical movements on anatomical axes that correspond to the range of normal or limited pathological joint movement are provided.

The structural innovations outlined enable the surgeon to (1) keep the patient in the supine position at all times (2) enable placement of the image intensifier to the opposite side of the patient (3) enable positioning of the image intensifier beneath the extremities for clear distinct viewing and (4) enable clear viewing (both anterior-posterior and lateral) without moving the patient and mobile image intensification unit from its initial set position, or moving the table. Storage or transfer of the table to another surgery or room for storage is easily accomplished by swinging the leg assembly traction units up to the sides of the table. The table can be condensed to a size approximately 3 by 6 feet.

The surgical table described is useful in orthopedic surgery, reduction of fractures or in general surgical applications where a mobile image intensification unit is desired, such as vascular surgery, heart surgery, lung surgery, location of bullets in the body, etc.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a surgical table having particular utility in conjunction with a mobile image intensification unit which includes an X-ray generator and an image intensifier mounted on the respective ends of a C-arc, an X-ray beam between the X-ray generator and image intensifier when in operation, the table providing an open area beneath the patient for the image intensifier or X-ray generator and permitting lateral and anterior-posterior views of that portion of the body of a patient to be treated in supine position on the table without change of position of the patient, the table having a central support pedestal, a body support extending horizontally and distally from the central pedestal including a sacral rest on the distal end thereof, pelvic engaging means functioning as countertraction means, a leg traction support assembly for the leg to be treated, and means providing support for the well leg of the patient, the improvement comprising providing a leg traction support assembly for the leg to be treated allowing unobstructed viewing of the entire length of the leg of the patient lying on the table in a supine position including (1) a supported hip arc unit having (a) a stationary portion disposed distally of the central support pedestal mounted for pivotal movement in a horizontal plane about a pivot point substantially coincident with the anatomical axis of the hip of the patient in a supine position on the table, and (b) a moveable portion moveable in a horizontal plane about a pivot point substantially coincident with the anatomical axis of the hip of the patient, (2) an adjustable-in-length traction rod secured to the moveable portion of the hip arc unit extending distally thereof, and (3) leg pulling means secured to

the distal end of the traction rod for supplying traction, the traction rod extending to the side of and beneath the leg to be treated extending between the body support and leg pulling means to permit unobstructed passage of the X-ray beam of the image intensification unit at any point along the leg for either lateral or anterior-posterior viewing and permitting application of a cast at any point along the leg, the entire leg traction support assembly moveable about axes substantially coincident with the anatomical axes of the patient so that the traction rod retains the same relation with the leg when the leg is moved either horizontally or vertically, and the distance between the foot of the patient secured to the leg pulling means and the hip joint remains essentially the same.

2. The table of claim 1 wherein the height of the table is such that the central beam of the X-ray generator in lateral position passes through the center of the leg to be treated with the image intensifier in the lateral X-ray projection position in its lowest position.

3. The table of claim 1 wherein the traction rod of the leg traction support assembly for the leg to be treated extends (1) alongside the outer length of the leg of the patient a sufficient distance to allow the upper face of the image intensifier to be brought up beneath the leg for clear anterior-posterior viewing, (2) a sufficient vertical distance from the horizontal surface on which the table is resting to allow the image intensifier in its lowered position to pass thereunder without obstruction, and (3) a sufficient distance beneath the leg to allow the upper face of the image intensifier to be positioned against the outer side of the leg to permit application of casts and for clear lateral viewing.

4. The table of claim 1 including a pair of spaced apart support rods extending proximally from the central pedestal, means attached to the support rods supporting the head and trunk of the patient on the table in a supine position, the support rods (1) positioned at a sufficient vertical distance from the floor on which the table is resting to allow the image intensifier or X-ray generator to pass thereunder without obstruction, (2) spaced apart a sufficient distance laterally of the midline of the body of the patient to allow the face of the image intensifier to be raised up closely adjacent the skin of the portion of the body of the patient to be treated for clear anterior-posterior viewing, and (3) positioned at a sufficient distance below the midline of the body of the patient to allow the face of the image intensifier to be brought laterally closely adjacent the skin of the patient for clear lateral viewing and to permit application of body casts.

5. In a surgical table having particular utility in conjunction with a mobile image intensification unit which includes an X-ray generator and an image intensifier mounted on the respective ends of a C-arc, an X-ray beam passing between the X-ray generator and image intensifier when in operation, the table providing an open area beneath the patient for the image intensifier or X-ray generator and permitting lateral and anterior-posterior views of that portion of the body of the patient lying in a supine position on the table to be treated without change of position of the body of the patient, the table including a central support pedestal, a body support extending horizontally and distally from the central pedestal including a sacral rest on the distal end thereof, pelvic engaging means functioning as countertraction means, a leg traction support assembly for the

leg to be treated, and means providing support for the well leg of the patient, the improvement comprising providing a support for the well leg including (1) a supported hip arc unit including (a) a stationary portion disposed distally of the central support pedestal and mounted for pivotal movement in a horizontal plane about a pivot point substantially coincident with the anatomical axis of the hip of the patient lying in a supine position on the table and (b) a moveable portion moveable in a vertical plane about a pivot point substantially coincident with the anatomical axis of the hip of the patient lying on the table, (2) a traction rod, adjustable in length, connected to the moveable portion of the hip arc unit, and (3) leg pulling means secured to the distal end of the traction rod for supplying traction to the well leg, the traction rod spaced inwardly toward the midline of the table and extending closely lateral to the well leg of the patient extending between the body support and the leg pulling means.

6. The table of claim 5 wherein the traction rod of the well leg traction support assembly extends closely lateral to the well leg in the area of the knee joint thereof and is pivoted for vertical movement at a point substantially coincident with the anatomical axis of the knee joint of the well leg.

7. In a surgical table having particular utility in conjunction with a mobile image intensification unit including an X-ray generator and an image intensifier mounted on the respective ends of a C-arc, an X-ray beam passing between the X-ray generator and image intensifier when in operation, the table providing an open area beneath a patient lying in a supine position on the table for the image intensifier or X-ray generator and permitting lateral and anterior-posterior views of that portion of the body of the patient to be treated without change of position of the body of the patient, the table including a central support pedestal, a body support extending horizontally and distally from the central pedestal including a sacral rest on the distal end thereof, pelvic engaging means functioning as countertraction means, a leg traction support assembly for the leg to be treated and a well leg support assembly for the well leg of the patient, the improvement comprising providing a leg traction support assembly for the leg to be treated and the well leg which includes (1) a floor support extending distally of the central support pedestal with the upper surface thereof being at a height from the floor on which the table is resting to allow the X-ray generator or image intensifier in its lowest position to pass thereover, (2) extensions pivotally connected to the floor support at pivot points beneath and substantially coincident with the hip joints of the patient lying in a supine position on the table, (3) vertically extending supports secured to the distal ends of the extensions at substantially equal distances from the midline of the table so that the image intensifier or X-ray generator can pass between the vertically extending supports and central pedestal without obstruction and so that the face of the image intensifier can be brought up beneath and closely adjacent the leg to be treated or the hip joint of the leg to be treated, (4) hip arc units secured to the vertically extending supports disposed laterally of the hip joints of the patient and moveable vertically about pivot points substantially coincident with the anatomical axes of the hip joints of the patient, (5) traction rods, adjustable in length, extending distally from the hip arc units, and (6) leg pull-

ing means secured to the distal ends of the traction rods for supplying traction.

8. The table of claim 7 wherein the arc of each of the hip arc units is of a length and radius to not interfere with the image intensifier or extend about the body support on which the patient is disposed.

9. The table of claim 7 wherein the hip arc unit for the well leg traction support includes coupling means variably secured to the hip arc unit to widely extend the range of motion of the rod in a vertical plane and offset toward the midline of the table from the hip arc unit so as to bring the traction rod attached thereto inwardly toward the midline of the table.

10. The table of claim 7 including a calf support secured to the traction rod of the well leg traction support assembly for supporting the calf of the well leg to support and furnish countertraction in a physiological manner when the knee is in flexion.

11. The table of claim 7 including a leg support secured to the traction rod of the leg to be treated at a desired position to aid in supporting the leg, the leg support being substantially transparent to X-rays.

12. The table of claim 7 wherein both hip arc units are the same and the traction rods for the well leg and injured leg are removable and reversible between the hip arc units.

13. In a surgical table having particular utility in conjunction with a mobile image intensification unit which includes an X-ray generator and an image intensifier mounted on the respective ends of a C-arc, an X-ray beam passing between the X-ray generator and image intensifier when in operation, the table providing an open, non-obstructed area for the image intensifier or X-ray generator beneath the patient to permit lateral and anterior-posterior views of extremities of the body of the patient without change in the position of the body of the patient from a supine position on the table, the table having a central support pedestal, a body support extending horizontally and distally from the central pedestal including a sacral rest on the distal end thereof, pelvic engaging means functioning as countertraction means, a floor support extending distally from the central support pedestal having its upper surface at a height from the floor on which the table is resting such that the X-ray generator or image intensifier in its lowest position can pass thereover without obstruction, the shape of the support being such as to not interfere with the forewheel of the image intensification unit, a leg traction support assembly for the leg to be treated, and a leg support assembly for the well leg of the patient, the improvement comprising providing:

A. a leg traction support assembly for the leg to be treated including: (1) an adjustable-in-length floor extension at a height from the floor on which the table is resting no higher than the floor support extending laterally and then distally from the floor support and pivotally attached thereto at a pivot point beneath the hip joint of the leg to be treated substantially coincident with the anatomical axis thereof permitting horizontal movement of the floor extension about the pivot point, (2) a vertically extending support secured to the distal end of the floor extension, (3) a distal arc unit including leg pulling and holding means secured thereto attached to the vertically extending support for movement in a vertical plane about a pivot point

substantially coincident with the anatomical axis of the hip joint of the leg to be treated,

B. a leg support assembly for the well leg of the patient including: (1) an adjustable-in-length floor extension at a height from the floor on which the table is resting no higher than the floor support and adapted to pass over or under the floor extension for the leg to be treated, the floor extension for the well leg extending laterally, then mesially and then distally from the floor support and pivotally attached thereto beneath the hip joint of the well leg substantially coincident with the anatomical axis of the hip joint to permit horizontal movement of the floor extension about the pivot point so as not to obstruct movement of the mobile image intensification unit, (2) a vertically extending support secured to the distal end of the extension, (3) a distal arc unit including leg pulling and holding means secured to the vertical extending support for movement in a vertical plane about a pivot point substantially coincident with the anatomical axis of the hip joint of the well leg.

14. In a surgical table on which a patient is lying in a supine position, an improved arm traction support assembly for the arm of the patient to be treated attachable to a support of the table adjacent the arm, the arm traction assembly having utility in conjunction with a mobile image intensification unit including an X-ray generator and an image intensifier mounted on the respective ends of a C-arc, an X-ray beam passing between the X-ray generator and image intensifier during

operation, the arm traction support assembly including:

A. an adjustable-in-length traction rod secured to the support of the table adjacent the arm to be treated, the traction rod pivotable vertically and horizontally about pivot points substantially coincident with the anatomical axis of the shoulder joint of the arm to be treated so that the traction rod retains the same relation with the arm when the arm is moved either horizontally or vertically, the traction rod extending to the side of and beneath the arm permitting an unobstructed path for the X-ray beam at any point along the arm for either lateral or anterior-posterior viewing, (B) arm pulling and holding means for holding either the arm extended or flexed at the elbow, and (C) counter-traction means.

15. The arm traction support assembly of claim 14 wherein the traction rod extends (1) alongside the outer length of the arm a sufficient distance to allow the face of the image intensifier to be brought up closely beneath the arm or shoulder joint for clear anterior-posterior viewing, (2) a sufficient vertical distance from the floor on which the table is resting to allow the image intensifier or X-ray generator to pass thereunder without obstruction, and (3) a sufficient distance below the arm to allow the face of the image intensifier in lateral position to be brought up closely adjacent the arm for clear lateral viewing thereof and to permit application of casts.

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