X-RAY EXAMINATION CHAIR

An X-ray examination chair is disclosed which is capable of swiveling and tumbling so that a patient restrained in the chair is positionable in various desired orientations for X-ray examination procedures.

The chair includes an adjustable X-ray film cassette holder mounted for swiveling about the chair's swivel axis and relative to the chair. The cassette holder is tumbled with the chair so that the cassette holder is readily positioned for X-ray exposures regardless of the chair orientation.

Restraints against undesired movement of the patient in the chair include a removable arm and thigh restraining means and an adjustable head restraint structure.

A restraining device for a child which positions a child for X-ray exposures adjacent the cassette holder is also disclosed.

13 Claims, 7 Drawing Figures
BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to X-ray examination equipment and more particularly relates to an X-ray examination chair for orienting a patient to desired X-ray exposure positions.

Certain X-ray examination procedures have required a patient to be oriented to various positions for sequential or individual X-ray exposures. An example of such a procedure is pneumoencephalography. This is an X-ray examination procedure in which air is injected into the patient's spinal column and permitted to rise to the top of the spinal column where fluid in the brain is displaced by the air. Thereafter the patient is oriented in various positions so that the location of the air, as the spinal fluid is displaced, can be observed by the use of an X-ray imaging device.

2. The Prior Art

Patients have been supported by chair-like devices which enabled orientation of the patient for X-ray exposures with the patient in a variety of positions. In the case of pneumoencephalography examination, X-ray exposures are made with the patient in six basic positions: (1) sitting upright; (2) a "brow down" position in which the patient is positioned with the spine generally horizontal and facing downwardly; 3. a "head hanging" position in which the spine is substantially vertical and the patient's head is adjacent the floor; (4) a "brow up" position in which the spine is horizontal and the patient faces upwardly; (5) a "left decubitus" position in which the patient's spine is horizontal and the patient's left side is adjacent the floor; and (6) a "right decubitus" position.

Examination chairs have been produced which produce a tumbling motion, i.e. a rotation of the chair about a horizontal axis, as well as for swiveling motion. These proposals have not provided chairs in which the patient was adequately supported in various required positions. In most instances, the prior art chairs employed a network of belt-like straps or a combination of straps and blanket-like body restraining elements which were wrapped about the patient's body to secure the patient to the chair. These devices were not sufficiently rigid to adequately restrain the patient's body against movement relative to the chair when the position of the chair was changed substantially. As a consequence, the patient was not only inadequately restrained but the patient was frequently subject to a certain amount of discomfort caused by the restraining devices.

Moreover, the prior art devices have not proposed suitable head restraints. In most of the prior art constructions, the head restraint assemblies were difficult to adjust properly, lacked rigidity and were supported on the chairs at locations which were not well suited for rigid support of a patient's head.

The prior art proposals have not provided conveniently arranged and operated X-ray imaging devices, such as X-ray film cassette holders. The prior art devices sometimes employed cassette holders for supporting X-ray film adjacent the patient's head. In some proposals these cassette holders formed part of X-ray equipment used in the examination. These arrangements made it quite difficult, in some cases, to make proper exposures. In other proposals, the cassette holders were detachably connected to the examination chair and frequently were required to be relocated during examination by detaching the reattaching them to the chair.

SUMMARY OF THE INVENTION

The present invention provides a new X-ray examination chair having patient restraining means which rigidly and comfortably supports a patient in the chair regardless of the orientation of the chair, and wherein an X-ray imaging device is quickly and easily positioned for exposures with respect to the patient regardless of the chair orientation.

In a preferred construction, the new examination chair includes a portable base assembly having a chair support assembly rotatably connected to it. A chair assembly is connected to the chair support by a swivel construction permitting the chair to swivel about an axis with respect to the chair support. The chair support and chair are connected to the base by a drive shaft which rotates about a horizontal tumbling axis which is transverse to the swivel axis. The examination chair is portable and can be used in any examination room provided with a standard ceiling X-ray tube mount, or a head, skull or neuroradiological unit.

The chair assembly includes a seat, a back and a leg and foot support. The seat is normally in a plane which is transverse to the back and the leg and foot supports but the chair can be straightened to form a stretcher if desired.

The patient is maintained in position on the chair by chest straps which extend diagonally across the patient's chest between two locations on the back of the chair. The patient's feet and lower legs are positioned on the leg and foot support portion of the chair by suitable straps. The arms and thighs of the patient are restrained by an arm and thigh restraint assembly which is removably connected to the chair.

The thigh and arm restraint assembly includes a pair of arm rest members which are connectable to the seat of the chair by a pantograph linkage. Each pantograph linkage enables movement of its associated arm rest member relative to the seat with the arm engaging portions parallel to the chair seat.

The arm rest members are connected together by an articulating rod assembly extending between them across the patient's lap. Thigh engaging elements are adjustable connected to the articulating rod assembly so that this rod assembly also restrains the patient's thighs. The arm rest members carry straps which are adjustable attachable to the chair seat. These straps are tensioned so that the thigh engaging elements tightly engage the patient's thighs and are then fastened in place to the seat. The patient's arms are than strapped to the arm rest members.

An X-ray exposure support structure is carried by the chair support. The X-ray exposure support rotatably connected to the chair support for orbital motion about the swivel axis of the chair. The X-ray exposure support is attached to the chair support so that the X-ray exposure support can be swivelled with the chair while maintained in position relative to the patient for an exposure. The exposure support is movable relative to the chair about the swivel axis so that the chair and patient may swivel with respect to the X-ray support structure or the exposure support structure may orbit about the chair and patient.

Further according to the invention, an improved head restraint assembly is provided which includes a head engaging device movably connected to the support frame on the chair. The head engaging device includes a chin or face rest and a strap which extends around the head. The chin rest is connected to the support frame by an adjusting rod and clamps so that the patient's head can be firmly yet comfortably restrained against movement with respect to the chair. The support frame extends from the back of the chair about the patient and provides additional lateral support.

In a preferred embodiment, an infant's seat is provided which can be attached to the chair during examination of an infant.

A principal object of the present invention is the provision of a new and improved X-ray examination chair which provides comfortable yet firm restraint of a patient in the chair and which is characterized by ease of obtaining X-ray exposures regardless of the orientation of the patient.

Other objects and advantages of the invention will become apparent from the following detailed description of a preferred embodiment made with reference to the accompanying drawings which forms a part of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an examination chair embodying the present invention;

FIG. 2 is a side elevational view of the chair of FIG. 1;
FIG. 3 is a view of a portion of the chair seen from the plane indicated by the line 3—3 of FIG. 1; FIG. 4 is a side elevational view of a portion of the chair shown in FIG. 1 and on a scale which is larger than the scale of FIG. 1, and with parts shown in different operative positions. FIG. 5 is a view of a portion of the chair shown in FIG. 2 and on a scale which is larger than the scale of FIG. 2; FIG. 6 is a side elevational view of a head restraining member of the chair of FIG. 1 and shown on a scale which is larger than the scale of FIG. 1; and FIG. 7 is a perspective view of a seat for an infant patient.

DESCRIPTION OF A PREFERRED EMBODIMENT

An X-ray examination chair 10 is illustrated in FIGS. 1 and 2. The chair 10 includes a base assembly 12 to which a chair supporting assembly 14 is rotatably connected. A chair assembly 16 is carried by the chair support 14 and is swivelable relative to the support. Patient restraints are associated with the chair assembly 16 for maintaining a patient in the chair as the chair is oriented to various positions with respect to the base 12. An X-ray exposure support structure 18 is also carried by the chair support assembly 14 for movement with the chair assembly relative to the base and can be used with any standard X-ray香蕉 tube mount or neuroradiological X-ray unit. The chair 16 is tiltable about the axis of rotation of the support 14 and swivelable so that the patient can be oriented as desired for examination.

The base assembly 12 includes parallel support legs 20 which preferably include casters 22 so that the chair is portable. The casters may be provided with a brake (not illustrated) for preventing movement of the base assembly 12 along the floor when undesired. A body 24 is supported by the legs 20 and a pedestal 26 extends upwardly from the body 24. The pedestal 26 houses an electric drive motor (not illustrated). Which is connected to a drive shaft 30 through a gear reduction (not shown). The drive shaft 30 extends from the pedestal 26 to the chair support assembly 14 and is rotatable about a horizontal axis of rotation 32. The pedestal drive motor is energized through a motor speed control circuit which enables the drive shaft to be driven through an adjustable range of 0 to 2 revolutions per minute whereby the chair supporting assembly 14 can be tilted with respect to the base. In the preferred construction, the chair can be tilted in either direction of rotation about the tiltable axis 32. The direction and speed of tilting is governed by the operator from a control panel 26a on the pedestal.

The chair supporting assembly 14 includes a main support member 36 which extends in a generally vertical plane and horizontally extending arms 38, 40. The arm 38 supports the chair assembly 16 while the arm 40 supports the X-ray exposure housing structure 18.

The chair assembly 16 is connected to the arm 38 through a swivel construction 42. The swivel construction 42 includes an electric drive motor which effects rotation of a drive shaft 43 through a suitable gear reduction. The electric motor and gear reduction may be of any suitable construction and are therefore not shown in detail.

The shaft 43 is driven through a swivel axis 44 which is perpendicular to and intersects the horizontal tumbling axis 32. Swiveling movement is limited to a 200 degree range about the axis 44 of construction although a greater amount of swiveling rotation may be obtained if desired. The swiveling speed of the chair is governed by motor speed control circuitry and the swivelling speed and direction is governed from the control panel by the operator.

The chair assembly 16 includes a seat section 50, a back section 52 and a leg and foot support section 54. The seat 50 has a base plate 56 fixed to the seat, and a side frame 58 and 60 which is supported by the base plate 56. The back 52 includes side frames 60, 62 and a top cross frame 64 extending between the side frames 60, 62. A back support member 66 is attached to the frame members 60, 62 and 64 to support the patient's back. An access opening 68 formed in the back support member 66 allows lumbar punctures to be made while the patient is seated in the chair.

The leg support 54 and back 52 are pivotally connected to the seat 50 so that the chair sections can be straightened out and locked in place to form a stretcher. During use as a stretcher, a head support element (not shown) is connected to the back 52 for supporting the patient's head and shoulders.

The patient restraints immobilize the patient's head, arms, legs and upper abdomen so that the patient cannot move with respect to the chair. The restraints include chest straps 70, 72 (FIG. 2) which diagonally cross the patient's chest and each other to maintain the patient's upper abdomen in one position in the chair. Each strap 70, 72 carries a shoulder pad 74 and has one end connected to the back section 52 by an anchor 76. The other end of the strap is connected to the opposite lateral side of the back section 52 by a buckle assembly 78. The straps 70, 72 are formed by a webbing of the type used for aircraft and automobile seat belts. In the preferred embodiment the buckle assemblies are of a conventional metal to webbing type in which a cam-like buckle locks the webbing against movement through the assembly.

The patient's feet and lower legs are immobilized on the leg support section 54. The leg support includes straps 80 extending around the patient's ankles. The straps 80 have self-adhering sections of the “fuzz latch” type which, when engaged, resist separation to firmly maintain the patient's ankles and feet in position. The “fuzz latch” is provided by a section of material defining a nap and an engaging material section composed of fibers defining hooks which engage the nap. The strap 80 is preferably of the same material as the strap 70, 72.

An arm and thigh restraining assembly 84 (FIGS. 3 and 4) immobilizes the patient's arms and thighs. The assembly 84 is formed by removable arm rest bodies 86, 88 which are detachably connectable to the seat section of the chair as a unit. Each arm rest body and the associated parts are identical and therefore only one arm rest body 86 is described in detail in its relation to the seat section, see FIG. 4. The arm rest body 86 forms one bar on a four bar linkage 90 of the pantograph type. The linkage 90 includes parallel links 92, 94 which extend between pivots on the arm rest body 86 and pivots on the fourth link 96.

The link 96 is formed by a metal sleeve having a C-shaped cross sectional configuration and which enables removal of the arm rest from the chair. The sleeve 96 telescopes onto a cylindrical bar 98 fixed to the seat section 50 of the chair. The bar 98 is parallel to the seat section 50 and therefore the linkage 90 maintains an arm engaging cushion 100 on the arm rest member 86 parallel to the seat regardless of the angular disposition of the parallel links 92, 94 relative to the plane of the seat section. The sleeve link 96 is removable along the bar 98.

The arm rest bodies 86, 88 are rigidly connected together by an articulating rod assembly 104 extending between the bodies and across the seat section 50. The articulating rod assembly 104 includes a rod member 104a and a surrounding sleeve 104b. The rod 104a is rigidly connected between each link 94. The links 94 are pinned to the opposite ends of the rod 104a and thus move as a unit. The sleeve 104b carries a pair of padded thigh immobilizers 106, 108. The thigh immobilizers are connected to the sleeve 104b by suitable adjusting clamps 110, 112, respectively. The arm rest bodies serve as bushings for 104a and as supports for sleeve 104b.

The assembly 84 is removed from the chair to enable the patient initially to sit in the chair. After the patient is seated, the assembly 84 is attached to the chair by telescoping the sleeves 96 over the seat bars 98 and clamping the sleeves 96 in position by tightening and locking the clamps 101 which act between the sleeves 96 and bars 98. The arm rest bodies are then lowered until the thigh immobilizers 106, 108 firmly engage the patient's thighs.

At this juncture, the arm rest bodies are secured to the seat section 50. In the preferred embodiment, each arm rest body
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Referring now to FIGS. 1 and 5, the X-ray exposure support structure 18 is carried on the arm 40 of the chair support structure and includes an X-ray film cassette holder 160 carried by a support rod 162 extending parallel to the swivel axis 44. The cassette holder 160 and support rod 162 move orbitally i.e., 360° rotation about the swivel axis 44 on a rotatable link arm 164. The link arm 164 is connected to the arm 40 by a pivot construction 166. An elongate slot 168 is formed in the arm 164. The rod 162 is adjustably mounted in the slot. The rod 162 is adjustably moveable along the arm 164 in the slot 168 to control the distance between the cassette holder and the swivel axis 44. The rod 162 can be locked in adjusted positions in the slot 168 by turning a locking knob 162c.

The cassette holder 160 is connected to the rod 162 by a clamp 170 which enables the cassette holder 160 to be slid up and down the rod 162 and maintained in adjusted positions. A universal ball and socket joint 174 connects the cassette holder 160 to the clamp assembly 170. The joint 174 enables the cassette holder to be tilted to otherwise universally moved relative to the clamp assembly if desired for a given X-ray exposure. The rod member 162 is formed by a sleeve member 162a telescoped over the rod member 162b. Further vertical adjustment of the cassette holder 160 is enabled by adjusting a clamp 175 between the members 162a, 162b.

A child's seat 176 for use with the new chair is illustrated in FIG. 7. The child's seat includes a seat support assembly 178 detachably mounted upon the chair 16 and a seat assembly 180 carried by the support 178. The support 178 includes a pair of arms 182 each of which is connected to the back section 52 of the chair assembly 16 by a sleeve 184 which fits over a respective one of the rod members 151. A clamp 186 is associated with each sleeve 184 to fix the sleeve in place on the rod member 151. Supports 188, 190 extend between the arms 182 and support a seat assembly 180.

Linkage plates 192 are also supported by the supports 188, 190. Each linkage plate 192 is slidable along the supports 188, 190 so that the linkage plates can be laterally adjusted.

The chair assembly includes a seat section 194, a leg support section 196 and torso immobilizers 198 located above the seat section 194. Link plates 200 extend along either side of the seat section 194 in confronting relationship with a respective one of the link plates 192. The lateral adjustments of link plates 192 on supports 188, 190 allow lateral adjustment of torso immobilizers.

Each link plate 200 carries followers 202, 204 which project from the link plate 200 through parallel angled slots 206, 208 formed in the link plate 192. The following rollers 206, 208, respectively, coact to form a parallelogram linkage between the adjacent link plates. The follower 202 is formed by a clamp knob and locks the link plates in place relative to each other in an adjusted position.

The back section 52 of the chair assembly 16 forms the back of the child's seat and it should be apparent from the inspection of the drawing that when the link plates 192, 202 are free to move relative to each other and a child is placed in the seat, the weight of the child and seat, when the seat is in the position illustrated in FIG. 7, urges the seat portion 194 of the child's seat downwardly until the child's back is supported against the back section 52 of the chair assembly 16. Conversely, the child's chest and torso is urged against the back section of the chair by the torso immobilizers 198. At this juncture the knobs 202 on each side of the child's seat are tightened and the chair is firmly restrained in position.

Straps, generally indicated at 212 are provided for securing the child's arms and legs in position. The cassette holder 18 is adjusted downwardly for appropriate positioning adjacent the child's head.

While a single embodiment of the invention has been illustrated and described herein in considerable detail, the present invention is not to be considered limited to the precise construction shown. It is the intention, therefore, hereby all adaptations, modifications and uses of the invention which come within the scope of the appended claims.
We claim:
1. In a medical examination chair:
   a. a base;
   b. a chair support member connected to said base for rotation about a horizontal tumbling axis;
   c. said chair support member including first and second support arms extending generally parallel to said tumbling rotation axis;
   d. a chair assembly disposed between said support arms and comprising at least a seat element and a back supporting element;
   e. swivel connection means between said seat element and said first support arm for enabling swiveling movement of said seat element about a swivel axis extending transverse to said tumbling axis and through said support arms;
   f. patient restraint means for maintaining a patient in a desired position with respect to said chair when said chair is oriented in various positions with respect to said tumbling and swivel axes; and,
   g. an X-ray imaging device support structure connected to said second support arm of said chair support member for rotation about said tumbling axis with said support member;
   h. said support structure comprising a supporting arm member, a second swivel connection means between said second support arm and said supporting arm enabling swiveling adjusting movement of said supporting arm about said swivel axis, an imaging device supporting rod projecting from said supporting arm toward said first support arm parallel to said swivel axis, said supporting rod orbitally movable about said swivel axis between desired X-ray exposure locations independently of swiveling of said chair, and means for adjusting the position of said supporting rod along said supporting arm radially relative to said swivel axis.
2. A chair as claimed in claim 1 wherein said imaging device comprises a film housing and means connecting said film housing to said supporting rod for movement between adjusted positions along said rod toward and away from said second support arm parallel to said swivel axis.
3. In a medical examination chair:
   a. a base;
   b. a chair support member connected to said base for rotation about a horizontal tumbling axis;
   c. said chair support member including a support arm extending generally parallel to said tumbling rotation axis;
   d. a chair assembly having at least a seat element and a back supporting element;
   e. swivel connection means between said chair seat and said support arm for providing swiveling movement of said seat about a swivel axis extending transverse to said tumbling axis;
   f. patient restraint means for maintaining a patient in a desired position with respect to said chair when said chair is oriented in various positions with respect to said tumbling and swivel axes; and,
   g. an X-ray exposure support structure connected to said examination chair;
   h. said patient restraint means comprising thigh engaging restraint members, movable link means connecting said thigh engaging restraint members to said chair assembly for adjusting movement toward and away from a patient's thighs, and means for securing said link means in a position with respect to said chair assembly wherein said thigh restraint members firmly engage a patient's thighs.
4. A chair as claimed in claim 3 wherein said patient restraint means further includes arm support members, said link means comprising first and second body members carrying said thigh restraint members and said arm support members, pantograph linkages connecting said first and second body members to opposite lateral sides of said chair assembly, and an articulating member extending between said body members for articulating motion thereof.
5. A chair as claimed in claim 4 and further including means for connecting said thigh restraint members to said arm assembly and:
   a. a generally V-shaped head engaging member resiliently deflectable to change the apex angle;
   b. at least first and second spring members supporting said head engaging member and exerting biasing forces on said head engaging member tending to reduce said V angle;
   c. means connected to said head engaging member to adjustably alter said V angle.
6. The examination chair claimed in claim 3 wherein said linkage means comprises a pantograph linkage and said thigh engaging members are maintained in a predetermined orientation with respect to said seat element during adjusting movement of said linkage means.
7. The examination chair claimed in claim 8 wherein said patient restraint means further comprises arm restraining means comprising arm supporting structure connected to said linkage means for movement with said thigh restraint members and means for securing a patient's arms to said arm supporting structure.
8. The examination chair claimed in claim 8 further including linking means support structure connecting said linkage means to said chair assembly, said linkage means support structure comprising at least a member movable along a path of travel generally parallel to said seat element for adjusting the location of said seat means and said thigh restraint members relative to said SEAT element toward and away from said link supporting element.
9. In a medical examination chair:
   a. a base;
   b. a chair support member connected to said base for rotation about a horizontal tumbling axis;
   c. said chair support member including a support arm extending generally parallel to said tumbling rotation axis;
   d. a chair assembly having at least a seat element and a back supporting element;
   e. swivel connection means between said chair seat and said support arm for providing swiveling movement of said seat about a swivel axis extending transverse to said tumbling axis;
   f. patient restraint means for maintaining a patient in a desired position with respect to said chair when said chair is oriented in various positions with respect to said tumbling and swivel axes; and,
   g. an X-ray exposure support structure connected to said examination chair;
   h. said patient restraint means comprising a patient's head supporting assembly connected to said chair assembly and comprising:
      1. structure defining first and second supporting surfaces for engaging opposite sides of a patient's head;
      2. spring means for biasing said surfaces toward engagement with each other;
      3. an adjustment member cooperating with said spring means to oppose the biasing force of said spring means and maintain said surfaces in spaced relationship; and,
      4. means supporting said adjustment member for movement between adjusted positions relative to said spring means to variably control the spacing between said surfaces.
10. The examination chair claimed in claim 11 wherein said spring means comprises first and second spring parts associated respectively with said first and second surfaces and further including a flexible member extending between said spring parts, said adjustment member connected to said flexi-
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13. The chair claimed in claim 12 wherein said flexible member is a generally V-shaped member supporting said surfaces adjacent respective ends of its projecting legs, said spring parts engaging said legs respectively and biasing said legs together, and said adjustment member connected to said flexible member at the apex thereof and movable to flex said member and alter the apex angle and therefore the distance between said surfaces.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,655,968 Dated April 11, 1972

Inventor(s) Robert M. Moore

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 29, "adjustable" should be --adjustably--;
Column 3, line 62, "200°" should be --220°--;
Column 4, line 60, "104aa" should be --104â--;
Claim 10: Column 8, line 35 "seat" should be --linkage--.

Signed and sealed this 19th day of September 1972.

(SEAL)
Attest

EDWARD M. FLETCHER, JR. ROBERT GOTTSCHALK
Attesting Officer Commissioner of Patents