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[54] **ANGIOGRAPHIC CRADLE**

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[51] **Int. Cl.** **A61g 13/00**, G01n 23/00

[58] **Field of Search** ..... 269/322-326; 128/1 R, 70, 134, 376; 250/54, 55; 5/69

[56] **References Cited**

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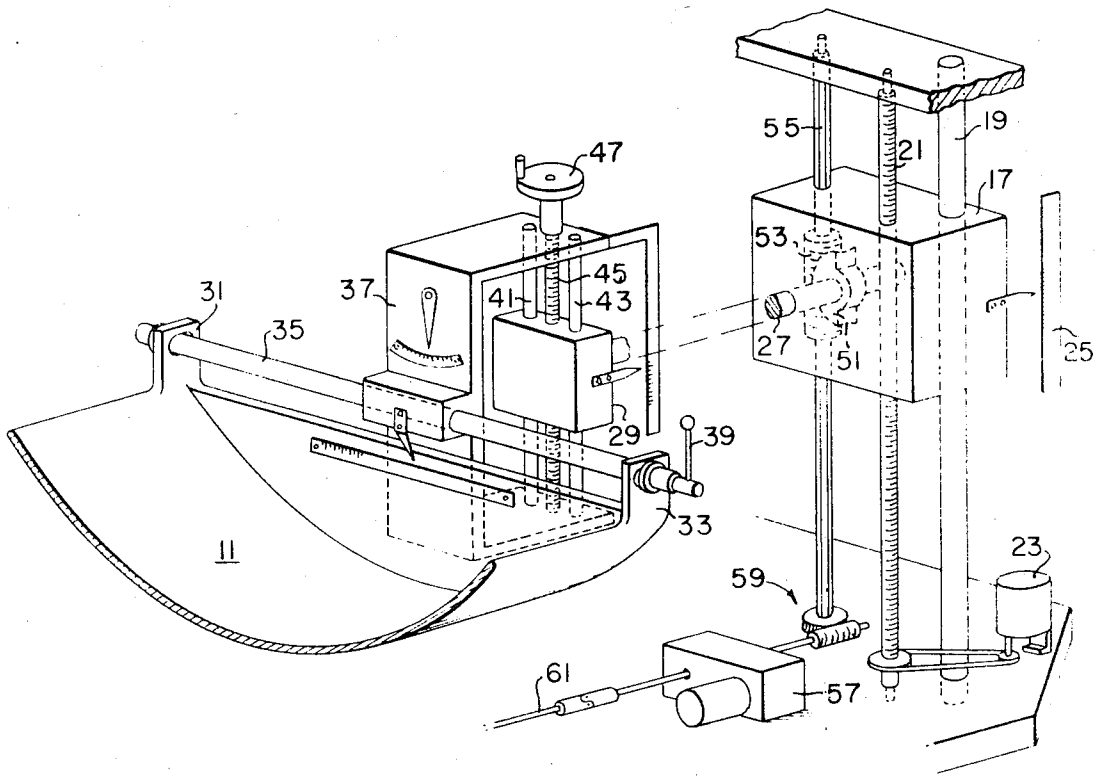
[57] **ABSTRACT**

The angiographic cradle disolosed herein permits a patient's body to be supported and rotated around a predetermined axis to facilitate radiological studies. The cradle itself is movable on two transverse axes with respect to the axis of rotation so that the axis of rotation can be caused to pass through a selected portion of the patient's body. In this way, changes in X-ray source and film plane spacings are avoided.

9 Claims, 3 Drawing Figures



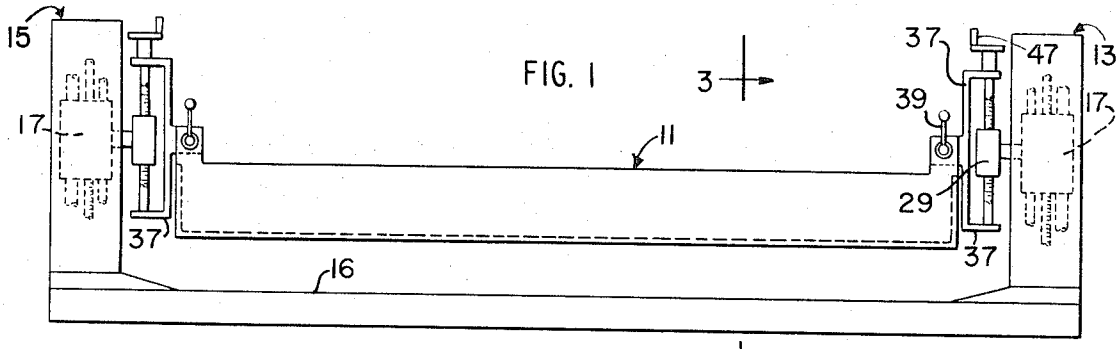


FIG. 1

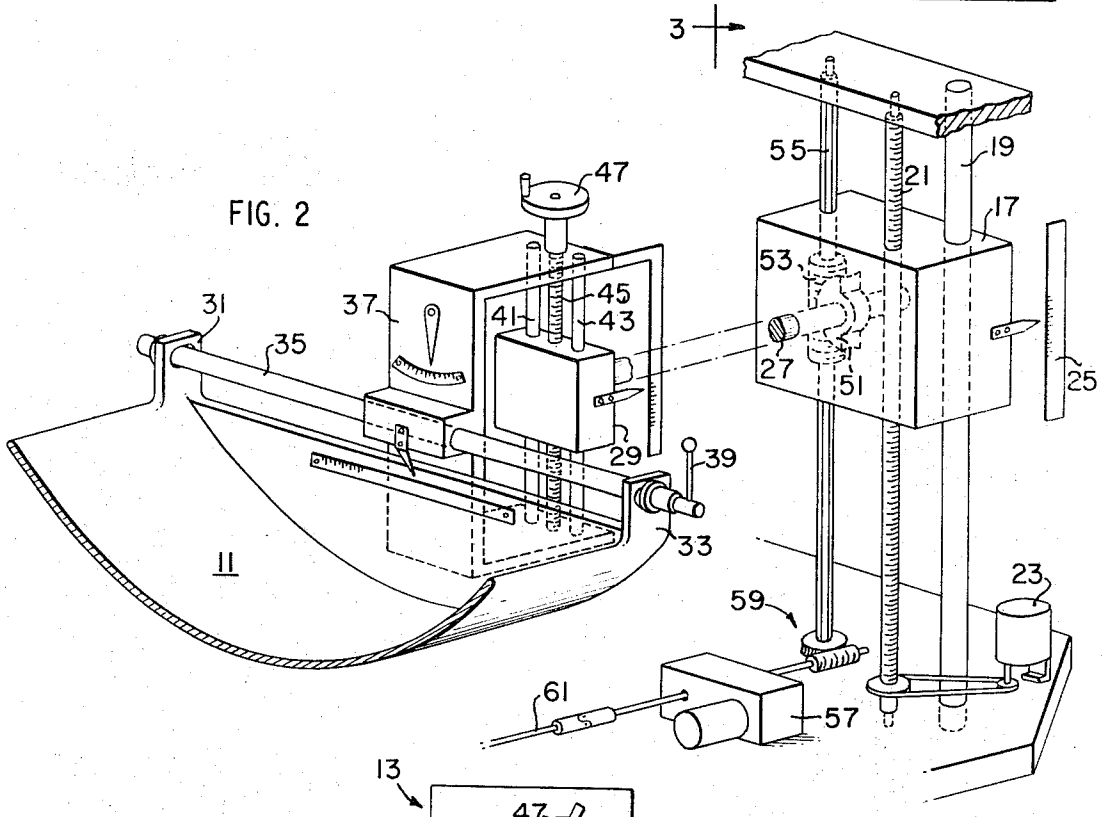


FIG. 2

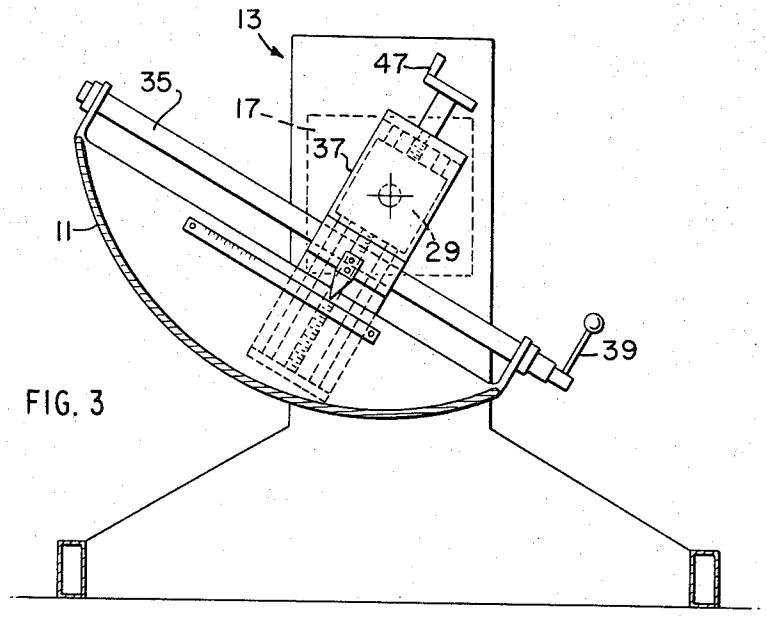


FIG. 3

ANGIOGRAPHIC CRADLE

BACKGROUND OF THE INVENTION

This invention relates to an angiographic cradle and more particularly to such a cradle which can be caused to rotate about an axis passing through a freely selectable point with respect to the cradle.

Various angiographic cradle arrangements have been proposed heretofore in which the cradle supporting the patient's body may be rotated to permit X-ray viewing from different angles. However, one difficulty which has been encountered is that the rotation provided would often also produce a change in the relative spacing between the portion of the patient's body under study and the X-ray source and film plane.

Among the several objects of the present invention may be noted the provision of a cradle for radiological studies which is rotatable about an axis passing through a selectable portion of the body of a patient held within the cradle; the provision of such a cradle arrangement which permits the entire cradle to be raised or lowered so as to change the scale magnification or expansion ratio; the provision of such a cradle arrangement which permits either end of the cradle to be raised independently to permit oblique angle studies and for treatment of hypotensive episodes; the provision of such a cradle arrangement which is easy to use and highly reliable and is of relatively simple and inexpensive construction. Other objects and features will be in part apparent and in part pointed out hereinafter.

SUMMARY OF THE INVENTION

Briefly, apparatus constructed in accordance with the present invention is adapted to locate the body of a patient so as to facilitate angiographical or other radiological studies. The apparatus includes an elongate cradle adapted to hold the patient and, at each end of the cradle, a support tower. Each tower supports a respective vertically slidable carrier and, associated with each tower, is a drive means for vertically positioning the respective carrier relative to the tower. An axis member is rotatably carried by each carrier and a two-axis traverse mechanism is provided at each end of the cradle for transversely positioning the cradle relative to the respective axis member. The apparatus also includes further drive means for concurrently rotating both of the axis members relative to the respective carriers so that the cradle can be rotated about the axis which is in turn caused to pass through a selected point with respect to the cradle itself.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of angiographic cradle apparatus constructed in accordance with the present invention;

FIG. 2 is a somewhat schematic perspective view of one end of the cradle apparatus, with parts broken away; and

FIG. 3 is a view of one end of the cradle and the respective supporting tower of FIG. 1, taken substantially on the line 3–3 of FIG. 1.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is indicated at 11 an elongate cradle adapted to hold a patient's body. The cradle is essentially trough-like in configuration so as to tend to retain the patient comfortably. The cradle is preferably constructed of a suitably radio-transparent material, such as fiberglas reinforced plastic resin. At each end of the cradle 11 is a support tower as indicated generally at 13 and 15, the towers being mounted on a base 16 passing beneath the cradle. The base is adapted to be removably mounted on a standard operating or X-ray table.

Within each tower is a vertically slidable carrier member 17. The carrier member 17 is guided by means of a post 19 and can be positioned vertically within the tower by means of a lead screw 21 which is in turn driven by a suitable motor drive as indicated at 23. As illustrated, the height of the carrier 17 may be indicated on a suitable scale 25. Such a scale is useful, as described hereinafter, for calculating scale expansion factors which arise as a function of the relative separation between the portion of the patient under inspection and the X-ray source and the film plane.

Journaled within the carrier 17 is a shaft 27 which extends in the direction generally paralleling the length of the cradle 11. The shaft 27 is rigidly connected to a slide block 29. The shaft and slide block together may be conveniently designated an axis member with respect to which the location of various other components is referenced, as described in greater detail hereinafter.

Each end of the cradle 11 hangs, by means of a pair of extensions 31 and 33, from a transverse tubular shaft 35, which in FIGS. 1 and 2 is shown as extending horizontally. Shaft 35 is in turn slidable laterally with respect to an intermediate frame member 37. Preferably, there is included within the tubular shaft 35 a conventional cam expansion lock (not shown) which can be controlled by means of a handle 39 at one end of the shaft 35 for locking the shaft, together with the cradle, in a given or selected transverse position with respect to the intermediate frame 37. In FIGS. 1 and 2 the shaft 35 and the cradle are centrally positioned with respect to the intermediate frame member.

The intermediate frame 37 is in turn vertically slidable with respect to the slide block 29, being guided with respect thereto by a pair of guide shafts 41 and 43 and being vertically positionable by means of a lead screw 45 which can be driven by means of a handwheel 47.

From the foregoing, it can be seen that the cradle 11 can be selectively positioned with respect to the block 29 and the shaft 27 on two orthogonal axes so that the axis of the shaft itself can pass through a selected or arbitrary point within a patient's body. In other words, a two-axis traversing mechanism has been provided at each end of the cradle so that the cradle can be positioned along either of two axes which are transverse to the longitudinal axis of rotation defined by the shaft 27. Assuming that the shaft 27 and block 29 are in the position shown in FIGS. 1 and 2, horizontal displacement is provided by means of the slide shaft 35 at each end of the cradle, while vertical displacements are obtained by means of the lead screws 45. However, as will be apparent hereinafter, the degrees of freedom provided by the two-axis traversing mechanism are relative, that is, they are with respect to the block 29, and these transverse axes themselves will rotate with the block during use of the cradle as shown in FIG. 3. The two transverse

axes of freedom do, however, remain orthogonal and the location of the longitudinal axis of rotation with respect to the cradle does not shift as the cradle is rolled about the longitudinal axis.

Each of the shafts **27** carries a sector gear **51** which meshes with a worm **53**, also journaled within the carrier **17**. As the carrier **17** is moved vertically by the lead screw **21**, the worm gear **53** slides on a splined vertical shaft **55** which serves as a means of coupling rotation to the worm gear independently of its vertical position. The splined shafts **55** at the two ends of the cradle are driven in synchronism by means of a gear motor **57** which is coupled to each vertical splined shaft through a suitable worm and ring gear arrangement, as indicated at **59** in FIG. **2**. A shaft **61** extending the length of the assembly through the base **16** underneath the cradle between and linking the two worms assures that the splined shafts **55** will rotate together. Since the splined shafts **55**, working through the worm gear **53** and sector gear **51**, control the rotation of the shafts **27** which are connected to the ends of the cradle, it can be seen that the two ends of the cradle will be caused to rotate concurrently and twisting or rocking of the cradle will be avoided.

From the foregoing, it can be seen that this apparatus greatly facilitates angiographic studies wherein a selected portion of a patient's anatomy is to be viewed from several different angles. By appropriately positioning the cradle itself with respect to the axis of shaft **27** so that the rotational axis passes through the selected portion of the anatomy, subsequent rotation of the cradle to present different angles to the X-ray apparatus will not cause any change in the distance between the selected anatomical feature and the X-ray source and the film plane. As will be understood, the film plane is generally in the X-ray table to which the cradle apparatus of the present invention will typically be mounted.

Since the two ends of the cradle can be driven vertically over a substantial distance, that is, limited only by the height of the two towers **13** and **15**, it can be seen that the present apparatus will also facilitate scale change or image magnification, when desired, by raising the subject toward the X-ray source and away from the film plane. As will be understood, this will produce an enlargement of the X-ray image with respect to the original subject. As is understood, this enlargement, however, may be accompanied by a slight loss of resolution. Where maximum resolution is required, the vertical drive motors **23** may be controlled by limit switches which sense the height of the cradle **11** above the base **16** so as to produce minimum clearance between the cradle and the base for all angular positions of the cradle based on rotation around the shafts **27**. In this way, minimum height and therefore maximum image resolution can be obtained automatically, even though the subject is rotated about an axis which is not concentric with the center of the radius of curvature of the cradle itself.

As indicated previously, separate motors **23** are provided for controlling the vertical height adjustment at each end of the cradle. In this way, the cradle may be tilted slightly with respect to its base which is useful in facilitating oblique studies and for treatment of hypotensive episodes. The extensions **31** and **33** are constructed to provide sufficient clearance and resiliency to accommodate the slight change in distance thereby introduced between the mounting shafts **35**.

In view of the foregoing, it may be seen that several objects of the present invention are achieved and other advantageous results have been attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it should be understood that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus for manipulating a patient;
an elongate cradle adapted to hold a patient;
at each end of said cradle, a respective vertically movable carrier;
drive means for vertically positioning each carrier;
an axis member rotatably carried by each carrier;
drive means for rotating said axis members relative to their respective carriers;
at each end of said cradle, means for traversing said cradle relative to the respective axis member along a first transverse axis; and
at each end of said cradle, means for traversing said cradle relative to the respective axis member along a second transverse axis, said second transverse axis being substantially orthogonal to said first transverse axis.

2. Apparatus for locating a patient for radiological studies, said apparatus comprising:
an elongate cradle adapted to hold a patient;
at each end of said cradle, a support tower;
supported by each tower, a respective vertically slidable carrier;
associated with each tower, drive means for vertically positioning the respective carrier relative to the tower;
an axis member rotatably carried by each carrier;
drive means for concurrently rotating both of said axis members relative to their respective carriers;
at each end of said cradle, means for traversing said cradle relative to the respective axis member along a first transverse axis; and
at each end of said cradle, means for traversing said cradle relative to the respective axis member along a second transverse axis, said second transverse axis being substantially orthogonal to said first transverse axis.

3. Apparatus as set forth in claim **2** in which, when said cradle is substantially level, said first transverse axis is essentially horizontal and said second transverse axis is vertical.

4. Apparatus as set forth in claim **3** including a lead screw for moving said intermediate member relative to said axis member.

5. Apparatus as set forth in claim **3** in which said cradle is mounted on an elongate bar which is slidable relative to said intermediate member.

6. Apparatus as set forth in claim **2** wherein said drive means for vertically positioning each carrier includes a lead screw in the respective tower.

7. Apparatus as set forth in claim **6** including separate motor means for independently driving each of said lead screws.

8. Apparatus as set forth in claim **2** wherein said drive means for rotating said axis members includes a first gear element on each axis member and a second gear

element journaled in the respective carrier and vertically slidable on a respective shaft adapted to couple rotation thereto and wherein said drive means includes also means for synchronously rotating said shafts.

9. Apparatus for locating a patient for angiographic studies, said apparatus comprising:

an elongate cradle adapted to hold a patient;

at each end of said cradle, a support tower;

supported by each tower, a respective vertically slidable carrier;

associated with each tower, drive means including a lead screw for vertically positioning the respective carrier relative to the tower;

independent motor means for rotating each of said lead screws;

an axis member rotatably carried by each carrier;

an intermediate member which is movable along one transverse axis relative to said axis member, said one transverse axis being essentially vertical when said cradle is level;

means for mounting said cradle on said intermediate member for movement on a second transverse axis which is substantially orthogonal to said one transverse axis, said second transverse axis being essentially horizontal when said cradle is level; and drive means for concurrently rotating both of said axis members relative to their respective carriers.

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