March 10, 1970 G. ROSSI 3,500,045

TILTABLE X-RAY TABLE SUPPORTING AN X-RAY TUBE AND DETECTOR FOR DISPLACEMENT AND ROTATION IN TWO DIRECTIONS RELATIVE TO THE TABLE

Filed Sept. 20, 1966 4 Sheets-Sheet 1

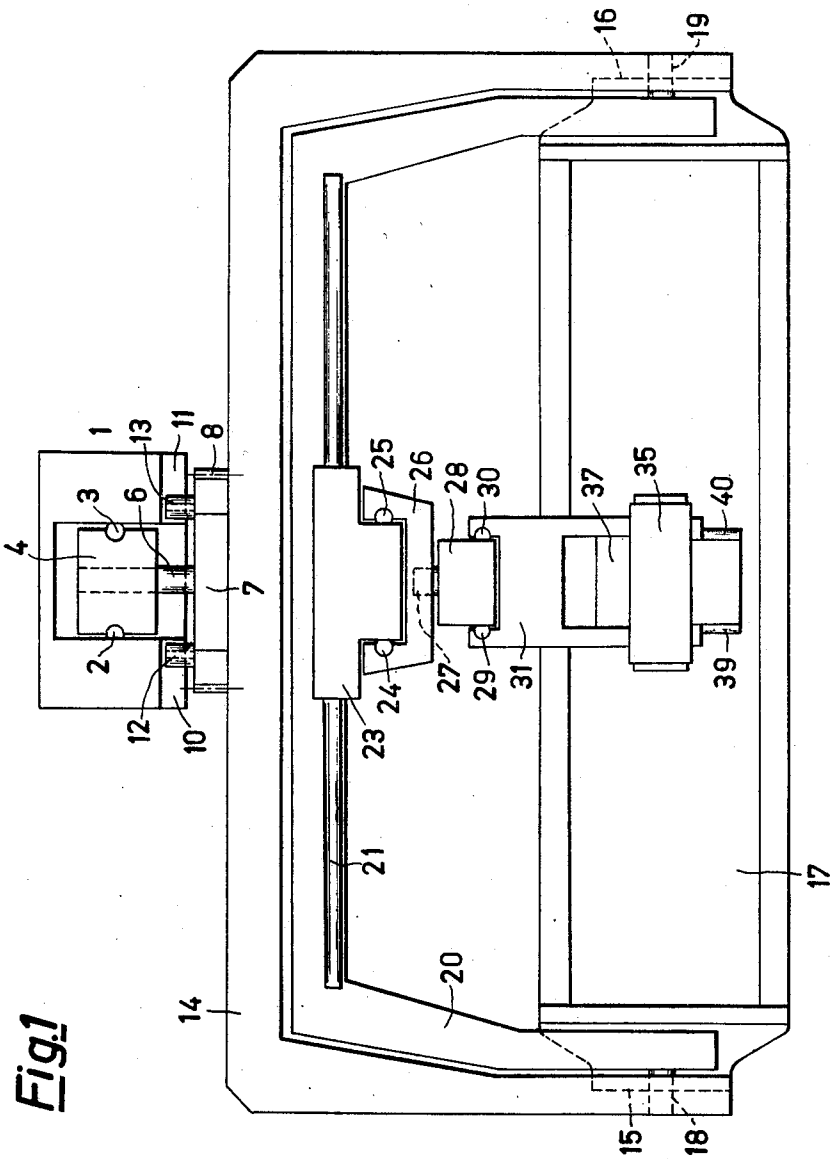

Fig.1

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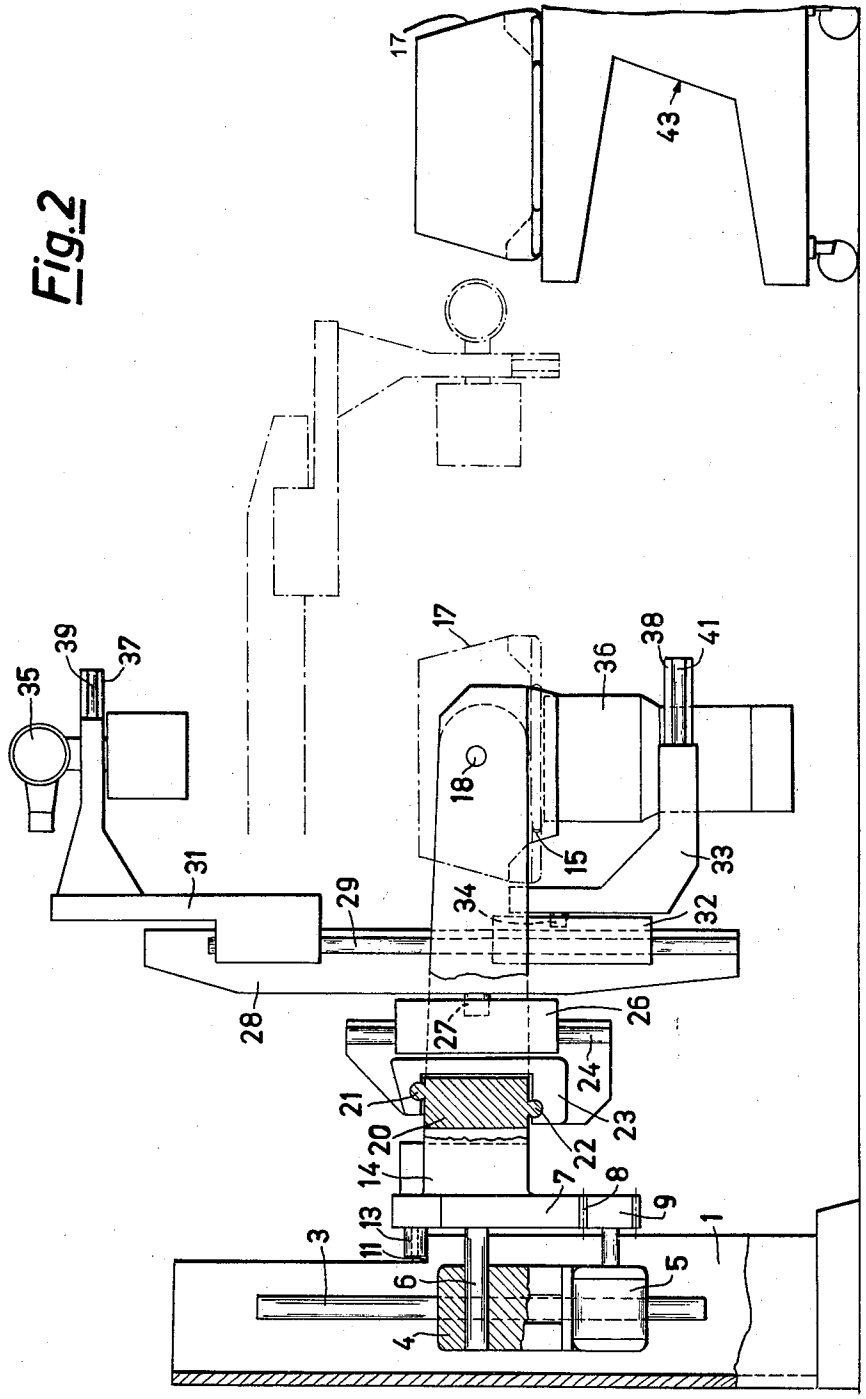
Fig.2



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TILTABLE X-RAY TABLE SUPPORTING AN X-RAY TUBE AND DETECTOR FOR DISPLACEMENT AND ROTATION IN TWO DIRECTIONS RELATIVE TO THE TABLE

Filed Sept. 20, 1966 4 Sheets-Sheet 3

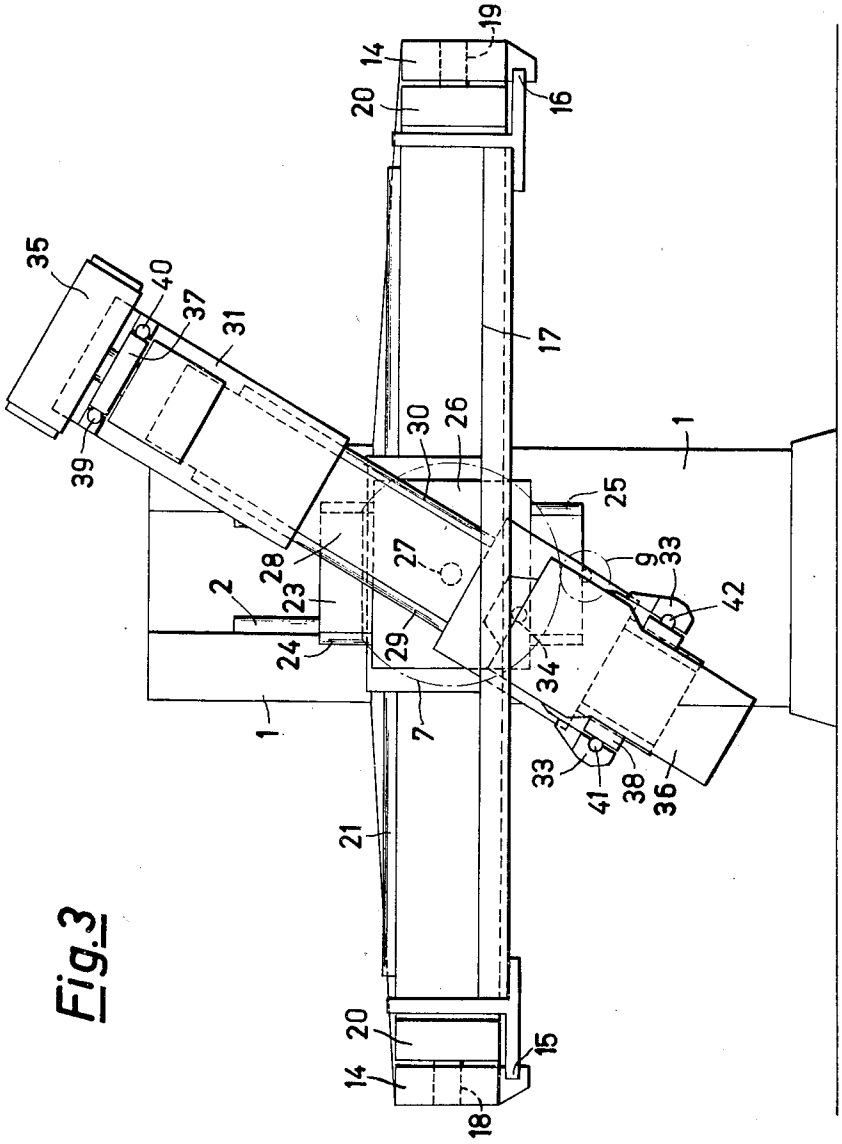

Fig.3

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TILTABLE X-RAY TABLE SUPPORTING AN X-RAY TUBE AND DETECTOR FOR DISPLACEMENT AND ROTATION IN TWO DIRECTIONS RELATIVE TO THE TABLE

Filed Sept. 20, 1966 4 Sheets-Sheet 4

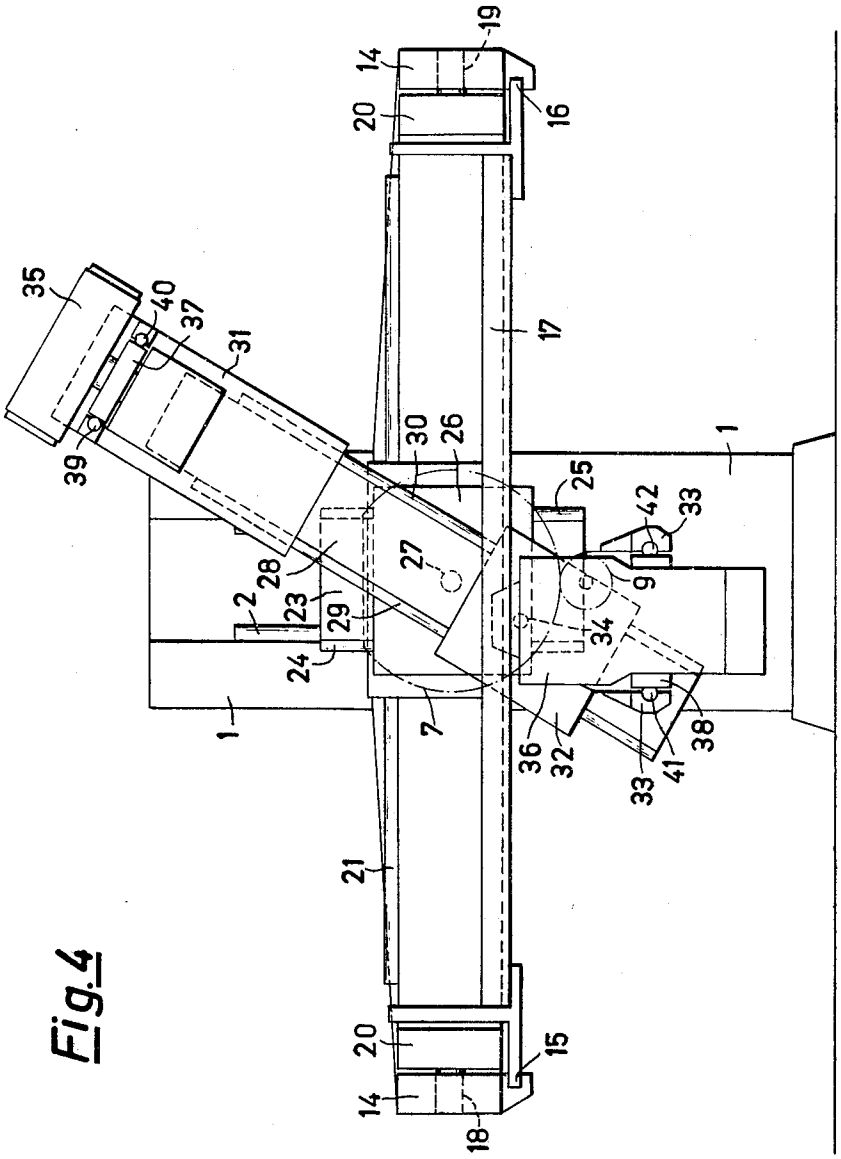

Fig. 4

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3,500,045

TILTABLE X-RAY TABLE SUPPORTING AN X-RAY TUBE AND DETECTOR FOR DISPLACEMENT AND ROTATION IN TWO DIRECTIONS RELATIVE TO THE TABLE

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Int. Cl. G01n 23/04
U.S. Cl. 250—57 7 Claims

ABSTRACT OF THE DISCLOSURE

A first fork member of an X-ray table receives a patient-carrying board and it is tiltable through 180 degrees about a horizontal axis, the first fork member supporting a second fork member for rotation about an axis perpendicular to the axis of rotation of the first fork member, the second fork member in turn supporting a carriage which is transversely displaceable between the arms of the fork members and on which carriage is rotatably mounted a swingable assembly for movement about an axis perpendicular to the axis of rotation of the second fork member with respect to the first fork member. On the swingable assembly are displaceable support arms for an X-ray source and a detector.

The tiltable X-ray tables known heretofore and conventionally used permit that the patient's system be viewed only with X-rays lying on planes perpendicular to the patient-supporting board, and parallel to the longitudinal axis thereof.

Said X-ray tables generally comprise the X-ray source, a ray detector in alignment with said source and a patient-supporting board positioned between said source and said detector.

Such tables permit a 90-degree rotation to be imparted to the patient-supporting board, in either direction, starting from the horizontal position. The frame of the patient-supporting board is in any case solid with the structural unit which carries both the X-ray source and the detecting device. The source is always positioned either beneath or above the patient-supporting board and, in combination with the detection device, is enabled to scan the patient-supporting board in horizontal plane only.

The above recalled circumstance that, in the conventional tables, the examination of the patient with X-rays can take place only along planes which are perpendicular to the patient-supporting board and parallel to the longitudinal axis thereof, is conducive to many a shortcomings and limitations.

As a matter of fact, when inspecting the human body, many organs can be encountered which display a different degree of opacity to X-rays: as a result, considerable difficulties are met in localizing the examination to a certain organ without suffering from the disturbance due to other, superposedly located or at any rate more or less opaque, organs.

A further drawback of the conventional tables is in that the X-ray source is always positioned either above or beneath the patient-carrying board.

Whenever X-ray inspections, both from above or from below must be effected, two tubes and two detectors should be used.

In a few conventional tables, the tube-detector assembly is allowed to assume oblique angles of incidence along planes which contain the longitudinal axis of the table and not perpendicular thereto, but in such tables, according to the embodiments known hitherto, no connection

exists between said assembly and the patient-carrying board, so that the movement are always handicapped.

This invention has the object of eliminating the shortcomings and limitations of the conventional tables while permitting X-ray examinations to be performed from any angle with respect to the patient-supporting plane, within a certain scanning area.

This invention thus relates to an X-ray table characterized in comprising, in combination, a first fork-shaped member for supporting the patient-carrying board and capable of being tilted through 180 degrees about a horizontal axis, and a second fork-shaped member, supported by said first fork-shaped member, rotatable about an axis perpendicular to said former axis, said second fork-shaped member carrying, rotatably about an axis perpendicular to the axis thereof, a swingable assembly formed by a carrier which supports an X-ray tube and a detector in opposed positions.

According to a preferred embodiment, the swingable X-ray tube and detector assembly is pivotally mounted on a carriage which is allowed to travel over parallel guideways affixed to said second fork-shaped member along a plane perpendicular to the plane of said fork-shaped member.

Furthermore, the X-ray tube and the detector are separately mounted, each, on a respective arm which can be displaceably and independently fastened on guides affixed to the swingable supporting assembly in a direction perpendicular to the axis of oscillation, so that their respective distances from the axis of oscillation of the swingable assembly can be varied independently of one another. Both the X-ray tube and the detector, moreover, are enabled to be displaced, as an entity, along said arms along a direction parallel to the axis of oscillation so as to permit the inspection of a patient in a transverse direction.

The detector-supporting arm, lastly, can be pivotally mounted on a slide, thus enabling said detector to be locked in a position coaxial to the X-ray tube or, alternatively, to maintain the sensitive plane of the detector parallel to the axis of rotation of said second fork-shaped member during the swinging movement.

By relying on the displaceability of the pendulum-like assembly about its own axis, and by virtue of the fact that said axis is carried by a slide which can be displaced on the carriage perpendicularly to the movement thereof and that the sesitive plane of the detector can be held parallel to the axis of rotation of the second fork-shaped member during swinging, the possibility is afforded of using the table for effecting planigraphies of any desired orientation.

An additional feature is the removability of the patient-supporting board, so that the patient can pe positioned in any particular posture by using, for example, an articulated chair, or it is possible to insert, in lieu of the rest board alone, special flats equipped with specific accessories, such as urological, orthopaedic, gynaecological accessories, and various devices, such as a seriograph, an amplifier and the like.

A device for the seating of the rotation axle of the first fork-shaped member can be utilized, which is adapted to allow said axle to be either lifted or depressed in order to ensure, during the rotation of the fork-shaped member, a minimum height from ground, consistent with the angle of tilt taken by the board.

The X-ray table according to the invention enables the relative positions taken by the three component parts (tube, patient and detector) be repeated in their mirror-imaged configurations with respect to a vertical plane containing the axis of the first fork-shaped member, while enabling the X-ray tube to be positioned either above or below the board with the detector in an opposed position.

This construction facilitates erection, the latter being no longer limited to the particular features of the environment in which it is to take place, work being also facilitated.

The supporting structure is hung on a wall resulting in a complete availability of the ground the whole area of interest throughout, said circumstance being a further aid to radiologicial operations.

All the movements of the several component parts of the table can be obtained with electric, mechanical or fluid-operated systems, remotely controllable, and known per se. Since these systems are not themselves a part of the invention, they will not be discussed in this specification.

One of the possible embodiments is shown in the accompanying drawings, wherein:

FIGURE 1 is a diagrammatical plan view of the table.

FIGURE 2 is a side elevational view of the same, with the swingable support for the X-ray tube and the detector in two extreme positions.

FIGURE 3 is a front view of the table, and

FIGURE 4 is a similar front view of the table as preset for performing planigraphies.

The table, as shown, comprises a supporting structure **1**, having vertical guideways **2** and **3**, along which a body **4** can be displaced, which carries a motor **5** and in which a pivotal pin **6** is freely and rotatably supported. Outside the structure **1**, the pivot **6** solidly carries a flange **7** having a toothed peripheral surface **8** in mesh with a pinion **9**, actuable by the motor **5**. The structure **1** has two rest planes **10** and **11** on which two rollers **12** and **13** can slide, said rollers being freely rotatable about their own axes and projecting from the rear of the flange **7** to which they are solidly fastened. Said flange **7** frontally supports a main fork **14** which can be rotated through 90 degrees both rightward and leftward about the axis of the pivot **6**. This rotation is controlled by the motor **5** through the pinion **9** and, by virtue of the rollers **12**, **13** acting as slidable fulcrums on the fixed planes **10**, **11**, a simultaneous lifting or lowering action is obtained for the body **4** which carries the pivot **6**, the flange **7** and the fork **14** solid therewith, along the guides **2** and **3** of the structure **1**. In the end portion of the two tines of the fork **14**, guideways **15** and **16** are formed, for inserting and supporting the patient-carrying board **17**, which latter can thus be removed and replaced.

On a horizontal axis perpendicular to the axis of rotation of the main fork **14**, the latter supports pivotal axles **18**, **19**, solid with a second fork **20**, which is allowed to rotate through 90 degrees about the common axis of the pivots **18** and **19**. On the back portion of the second fork **20** is slidably mounted on longitudinal guideways **21** and **22** a carriage **23**. On this carriage in turn is slidable, along a perpendicular direction and on guideways **24** and **25**, a slide **26**; said slide rotatably supporting a pivot **27**, solid with a supporting member **28**. Along longitudinal guideways **29** and **30** affixed to the supporting member **28**, are slidably affixed, independently of one another, an L-shaped arm **31** and a slide **32** carrying a second L-shaped arm **33** rotatable about a pivot **34**. On end forned out portions of said arms **31** and **33** are mounted the X-ray tube (diagrammatically shown) **35** and the detector device **36** which are thus located in opposition with respect to the board **17**. Both the tube **35** and the detector **36** are mounted on drawers **37**, **38** having side guideways **39**, **40** and **41**, **42**, respectively, slidable in the end portions of the respective supporting arm **31** and **33**, means (not shown) being however provided for uniting the drawers **37**, **38** as an entity during said displacements in the end portions of the supporting arms.

The combination of the above enumerated parts thus permits that the main fork **14** can be tilted through 90 degrees rightward or leftward with respect to a horizontal plane, the same being true for the patient-supporting board. The second fork **20** and therewith the supporting

member **28** carrying the X-ray tube and the detector can also be tilted through 90 degrees on the plane perpendicular and transverse to the axis of the pivots **18** and **19** and of the board **17**. The swingable support **28** can be rotated through 360 degrees, independent displacements of the X-ray tube **35** and the detector **36** being likewise permitted.

The supporting arm **33** of the detector **36** is rotatable on the slide **32**, means (not shown) being provided for locking the arm **33** so that the detector is opposedly and coaxially mounted with respect to the X-ray tube **35** when the table is used for the usual skiagraphies. By unlocking the arm **33** and allowing it to be rotated about the axis of the supporting member **34**, one can obtain that the sensitive plane of the detector is maintained constantly parallel to the axis of rotation of the second fork **20** during the swinging movement of the supporting member **28**, whenever planigraphies and the like (see FIG. 4) are to be effected. To vary the level of the planigraphy with respect to the plane on which the patient lies, the position of the slide **26** is varied with respect to that of the carriage **23**, thus shifting the center of rotation (pivot **27**) of the swingable supporting assembly **28**.

FIGURE 2 diagrammatically shows a carriage **43** which can be used for inserting or removing a board **17**, to replace it with another board. The same figure diagrammatically shows in phantom the extreme position the swingable supporting assembly **28** can take when the second fork **20** is titlted through 90 degrees about the axis of the pivots **18** and **19** with respect to the normal position.

It should be noted that, in order to simplify both the disclosure and the drawings, the means for controlling the several movements of the component parts of the table have not been shown. By suitably balancing said component parts, said movements could be manually controlled.

What is claimed is:

1. An X-ray table comprising a first fork member adapted for supporting a patient-carrying board and tiltable through 180° about a horizontal axis, said fork member including spaced arms for supporting said board, a second fork member within said arms and pivotably supported thereby for rotation about an axis perpendicular to the axis of rotation of said first fork member, and a swingable assembly rotatably mounted on said second fork member for movement about an axis perpendicular to the axis of rotation of said second fork member with respect to the first fork member, said swingable assembly including support means for an X-ray source and a detector.

2. An X-ray table as claimed in claim **1** comprising a carriage slidably mounted on said second fork member for transverse movement between said arms, said swingable assembly being supported by said carriage.

3. An X-ray table as claimed in claim **2** comprising a slide on said carriage pivotably supporting said swingable assembly, said slide being displaceable on said carriage in a direction perpendicular to the direction of displacement of the carriage.

4. An X-ray table as claimed in claim **1** wherein said swingable assembly includes guides extending in a direction perpendicular to the axis of rotation of said swingable assembly with respect to said fork member, said support means comprising arms respectively supporting the X-ray source and detector from said guides for independent movement therealong.

5. An X-ray table as claimed in claim **3** comprising means for displacing the X-ray source and detector on their respective arms in synchronism to retain a mutual coaxial relation therebetween.

6. An X-ray table as claimed in claim **4** comprising a displaceable slide on said swingable assembly pivotably supporting the arm of the detector and means for locking

said arm relative to the slide in a position in which the detector is coaxial with the X-ray tube, and also for unlocking the arm from the slide to permit a sensitive plane of the detector to remain parallel to the axis of rotation of the second fork member during pivotable movement thereof.

7. An X-ray table as claimed in claim 1 comprising means on said arms of said first fork member for removably supporting the patient-carrying board.

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