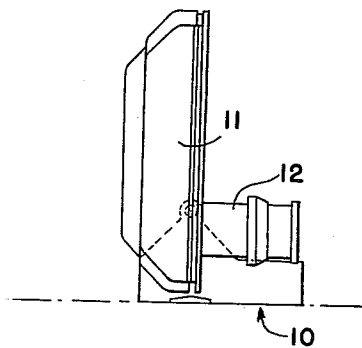
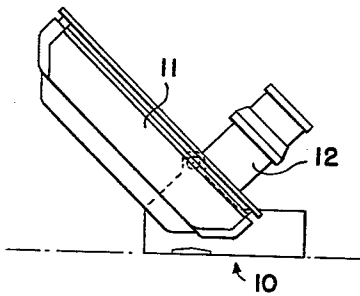
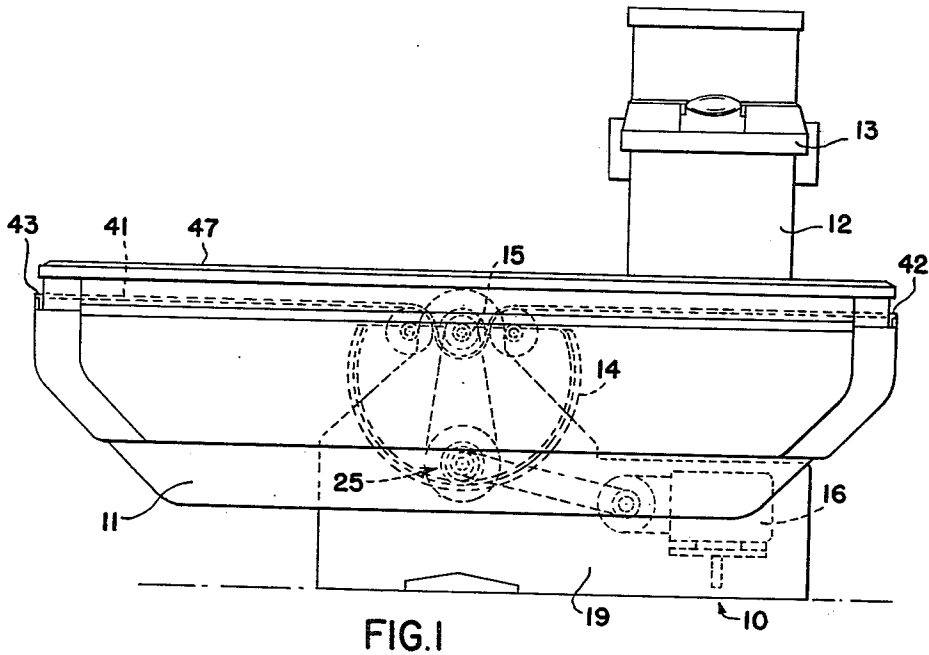


April 28, 1964

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TILTABLE X-RAY TABLE COMPRISING MEANS TO PRODUCE
A VARIABLE SPEED TRANSLATIONAL MOVEMENT
Filed June 26, 1961

3,131,301

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

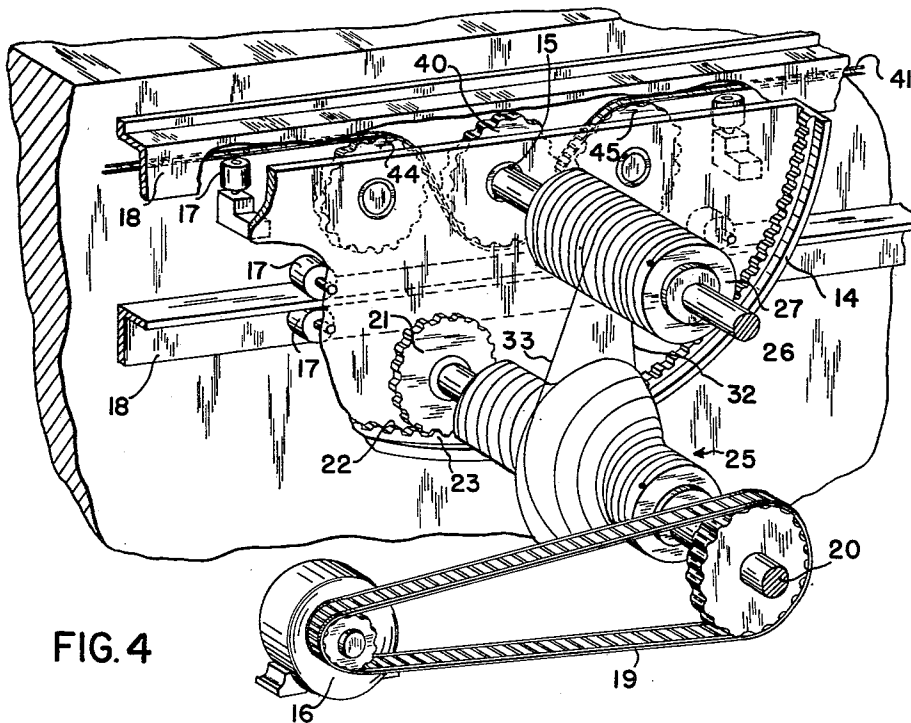


FIG. 4

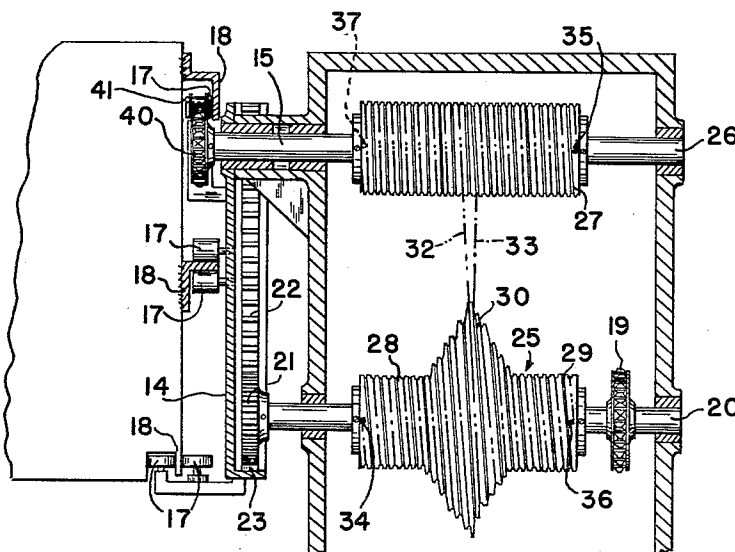


FIG. 5

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TILTABLE X-RAY TABLE COMPRISING MEANS TO PRODUCE A VARIABLE SPEED TRANSLATIONAL MOVEMENT

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14 Claims. (Cl. 250—55)

This invention pertains to X-ray tables of a tiltable type.

In tiltable X-ray tables, a body is positioned on a supporting pedestal for relative tilting movement. The body is normally positioned with a top patient support surface disposed in a horizontal plane. In the most versatile tables, the top is tiltable 90° in either direction from its horizontal position to either of two vertical or upright positions. A patient, then, may be examined when in either a horizontal prone position or either of two vertical positions, one upright and the other inverted. Tables of this type are known as 90-90 tables.

Normally an X-ray tube is beneath the table top and housed within the body. This tube is movable relative to the body over substantially the entire length of the top. The body must have substantial volume to provide full shielding and protection in all directions against scatter and stray radiation emanating from the X-ray tube while permitting the desired tube movement. This substantial body volume creates some problems in obtaining an ability to tilt from the horizontal 90° in either direction to the vertical.

One reason that these problems exist is that it is important that the table top be relatively low in order that the physician and his associates conducting an examination may view a fluoroscopic screen above a patient. If the top is too low, the table body will, because of its volume, interfere with the tilting movement, when the table top is tilted from the horizontal to one of the vertical positions.

A number of proposals have been made to provide a low table which still has ample floor clearance when tilted from the horizontal to the vertical. One such proposal is a system which provides a spaced pair of pivots, each of which is relatively near one end of the table. Each pivot is used for tilting the table in one direction only. The principal disadvantages of this system are (1) the patient moves away from the doctor when the table is tilted and (2) a substantial amount of surrounding space is required.

Another proposal has been the use of a large supporting ring. With this arrangement the entire table rotates about the axis of the ring from the horizontal to the vertical positions. Again, a substantial amount of room is required for housing the table and again the patient and table body tend to move away from the physician. Additionally, the ring interferes with certain radiological techniques. In order to provide a study surface which is low enough with this ring-supported class of table, some attempts have been made to move the table relative to the ring when the top is in the horizontal position. Thus, the table, once positioned horizontally, is lowered for a horizontal examination. This creates some substantial mechanical problems and results in a rather complex and expensive table.

Another solution which has been proposed for this general problem is that described in United States Patent No. 2,872,584 to R. C. Schiring et al. and issued February 3, 1959. With the table of that patent, a pedestal is provided which has a supporting pivot. The body is supported on the pivot. As the table is tilted in either direc-

tion it simultaneously shifts translationally relative to the pivot to provide adequate clearance. The present invention is directed to a table of the class described and claimed in the Schiring patent.

With the present invention, the translation of the table body is non-linear. That is, the body is shifted translationally at a relatively high speed at the beginning of a tilting operation. The major portion of the translational movement is immediately obtained while the tilting is at a uniform rate. With this technique the table body is quickly shifted translationally out of the way to obtain maximum clearance. This high-speed translational shifting of the table permits the pivot and the table top to be lowered a substantial amount as compared with the table of the referenced patent.

In the disclosed arrangement of the present invention, this non-linear translational movement is obtained by the use of a pair of spirally convoluted cams and cables reeved around them. One of the cams is powered and the other is connected to a sprocket which drives the table body translationally. In the preferred arrangement, the powered cam has a variable diameter while the driven cam is a drum of constant diameter. With the powered or driving cam having a variable diameter, the initial relative movement between the two cams is relatively high, diminishing as the translation progresses.

One of the principal objects of this invention is, then, to provide a novel and improved X-ray tilt table in which a major portion of the translational movement of the table body relative to the pedestal is obtained prior to the time when the tilting movement reaches its critical clearance position.

Another object of this invention is to provide a novel and improved X-ray tilt table in which simultaneous translation and tilting movement are obtained and in which the translational movement is non-linear starting with a relatively high speed and diminishing as the translation continues.

An additional object of the invention is to provide a 90-90 table in which the table body is shiftable both tiltable and translationally relative to a pivot in either direction from a horizontal and in which the translational movement is non-linear while the pivotal movement is constant.

In the table described in the above-referenced patent, and in the table of this invention, the tilting is obtained by the coaction of a pinion and a relatively large gear segment, the segment is connected to the table body and meshed to the pinion. In the table of the referenced patent, the gear teeth on the segment are on the external convex surface of the segment. With the present invention the height of the table is further lowered through the utilization of a gear segment in which the teeth are internal on a concave surface. This permits the driving pinion to be positioned within the contour of the segment rather than externally of it. Since the geometry of the table is such that to obtain 90-90 movement the pinion gear must be positioned in a vertical plane located by the axis of the gear segment and pivot, placing the pinion within the contour of the internal gear segment, permits the table to be lowered an amount equal to the diameter of the pinion plus the thickness of the segment.

Accordingly, another and more special object of this invention is to provide a novel and improved table in which tilting is obtained by coaction of a pinion and a gear segment and in which the gear segment is an internal gear.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a front elevational view of the novel and improved table;

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FIGURE 2 is a front elevational view of the table of FIGURE 1; on a substantially reduced scale, showing the table in a partially tilted position;

FIGURE 3 is a front elevational view on the scale of FIGURE 2 showing the table in a fully tilted position;

FIGURE 4 is an enlarged perspective view of the novel and improved tilting mechanism; and

FIGURE 5 is a sectional view of the tilting mechanism on a further enlarged scale.

Referring now to the drawings and to FIGURE 1 in particular, a table pedestal is shown generally at 10. A table body 11 is supported by the pedestal for relative movement. A fluoroscopic tower 12 is carried by the table body for relative longitudinal and transverse movement. The tower 12 may support the usual spot film device 13 and an X-ray tube, not shown, which is positioned within the body 11. The table body 11 is supported by the pedestal 10 in a manner corresponding to that described and claimed in greater detail in the Schiring et al. patent referenced above.

This support includes a gear segment assembly 14 journaled on a pedestal pivot 15 which is near the top of the pedestal 10. A plurality of rollers 17 are connected to the gear segment assembly 14. These rollers coact with the suitable guide tracks 18 on the table body 10 to support the body 10 for relative translational movement.

A reversible essentially constant speed electric motor 16 is positioned within the pedestal 10. A chain 19 connects the motor 16 to a drive shaft 20. A pinion gear 21 is secured to the drive shaft 20. The pinion gear 21 meshes with internal teeth 22 formed on the concave surface of a gear segment 23. The gear segment 23 is part of the segment assembly 14.

A spirally convoluted driving cam or sheave 25 is secured to the drive shaft 20 intermediate its ends. A translation producing shaft 26 is journaled in the pedestal in axial alignment with the pivot 15. A second spirally convoluted driven cam or sheave 27 is secured to the translation producing shaft 26. In the preferred and disclosed arrangement, the drive sheave 25 is of variable diameter. The sheave 25 preferably has spaced constant diameter drum portions 28, 29 and a central variable diameter portion 30. The second or driven sheave 27, on the other hand, is a constant diameter sheave.

Referring now more specifically to FIGURE 5, a pair of drive cables 32, 33 are provided. The first of these drive cables 32 has one end secured at 34 to the left hand end of the drive sheave 25. The other end of this first cable 32 is secured at 35 to the right-hand end of the driven sheave 27. The second of the drive cables 33 has one end secured at 36 to the right-hand end of the drive sheave, and the other end secured at 37 to the left-hand end of the driven sheave. As the driven sheave is rotated in one direction, the cable 32 will wind off of the drive sheave and wind onto the convolutions of the driven sheave 27. Simultaneously, the other cable will be wound onto the spiral sheave or driving sheave 25 and off of the driven sheave 27. This double cable arrangement provides a positive drive and a constant tension on both cables.

The cables 32, 33 each have their own coacting convolutions on each of the drums. There are then two spiral convolutions on each drum oriented 180° from one another. In this manner, the cables 32, 33 are positioned on opposite sides of the drums but they still produce equal mechanical advantage and simultaneously wrap onto and off of the drums at the same rate.

This use of two cables 32, 33 provides a uniform application of the driving forces. To further facilitate such uniform application and to facilitate the simultaneous winding and unwinding of the two cables, the sheaves are spaced, parallel, and of equal length. With this construction, the portions of the cables stretched from one drum to the other are always essentially vertical coming on and off the sheaves at optimum angles.

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A drive sprocket 40 is connected to the inner end of the translation shaft 26. The drive sprocket 40 meshes with a chain 41 secured at its ends to the table body at 42, 43 in FIGURE 1. The chain 41 is reeved over a pair of idler sprockets 44, 45 so that rotation of the sprocket 40 in the same direction as the tilting rotation of the table body, will cause translational movement of the table body 11 in the appropriate direction.

Operation

In FIGURES 1, 4, and 5 the table body is shown with its top 47 in a horizontal position. If it is desired to shift the table body to the position shown in FIGURE 3, it is necessary to cause the drive shaft 40 to rotate in a direction which is counterclockwise as seen in FIGURE 4 and clockwise as seen in FIGURE 1. Referring then to FIGURE 4, the motor 16 is energized to cause the drive shaft 20 to rotate in a counterclockwise direction. This will cause the tilting pinion 21 to rotate. As the tilting pinion 21 rotates, it will mesh or coact with the gear segment 23 to rotate the gear assembly 14 about the pivot 15 tilting the table body relative to the pedestal 10. Simultaneously, translational movement of the body 11 is obtained.

As the drive shaft 20 rotates in this described direction which is counterclockwise with respect to FIGURE 4, the cable 33 winds off the driving sheave 25 and onto the driven sheave 27. Simultaneously, the cable 32 is wound onto the driving sheave 25 and off the driven sheave 27. Since, at the start of this tilting operation, the cables 32, 33 are coming on and off the central portion 30, which is the portion of greatest diameter, the driven sheave 27 will initially be rotated at its greatest speed. As the rotation continues the cables will be wound on and off parts of the driving sheave of decreasing diameter so that the driven sheave 27 will rotate at a decreasing speed. This decrease in speed will continue until the cables are winding on and off the left-hand constant diameter portion 28. Thus, in moving from the position of FIGURE 1 to FIGURE 2 a non-linear decreasing speed of translation is provided.

At approximately a 45° position, or about the position of FIGURE 2, the translational movement changes from a decreasing speed to a constant speed. The concluding translational movement as the table tilts from its FIGURE 2 to its FIGURE 3 position is of constant speed.

The need for this high initial speed of translation is best understood by reference to FIGURE 2. The critical point of clearance is at approximately 45° where the corner of the table approaches the floor. If high speed of translation has been obtained, the table body has been shifted out of the way quickly. Since the table body has been shifted out of the way quickly, it is able to start initially in a position which is closer to the floor than was possible with prior known constructions.

As a specific illustrative example, the table shown in the referenced patent (if it has so-called focal distance of 18 inches) will have its table top 33 inches from the floor. This so-called focal distance is the distance from the X-ray emitting focal spot on the X-ray tube target to the table top. With an identical X-ray tube and focal distance of 18 inches, it is possible to position the table top 47 of this invention at about 29 inches above the floor and still obtain full clearance through tilting from horizontal to either vertical position. Accordingly, the table height is decreased by 12½% or more through the features of this invention.

While the invention has been described with a great deal of detail it is believed that it essentially comprises an X-ray table having a body pivotally supported on a pedestal, means to tilt the table body relative to the pedestal and to shift the body translationally relative to the pedestal, and wherein a major portion of the translational movement is obtained before the tilting movement reaches its 45° position.

Although the invention has been described in its pre-

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ferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. In an X-ray table having a patient supporting table body tiltably carried by a pedestal in a tower moveably connected to the body, the combination of, a pivot means interposed between the pedestal and the body for tilting the body relative to the pedestal, and translation producing means connected to the body and to the pedestal to shift the body translationally relative to the pedestal simultaneously with such tilting, and said translation producing means including a variable drive means so that said translational movement is at varying rates of speed.

2. The device of claim 1 wherein said variable drive means includes a variable diameter sheave.

3. The device of claim 1 wherein the speed of translation decreases as the top is shifted from a horizontal to a vertical position.

4. The device of claim 1 wherein the tilting means includes at least a segment of a toothed ring gear and a coating pinion engaged with the ring gear teeth and wherein the ring gear teeth are along the concave surface of the gear.

5. An X-ray table comprising a pedestal, power means carried by the pedestal, a pinion gear drivingly connected to and driven by the power means, a pivot connected to the pedestal, a table body movably mounted on the pedestal, a segment of a ring gear connected to the table body, the ring gear having an inner toothed concave surface, the teeth of said surface being engaged by the pinion, body translation drive means carried by said pedestal and drivingly connected to the power means, and the body translation means being connected to the body and including a variable speed drive means to shift the body translationally at varying speeds as it is tilted.

6. The device of claim 5 wherein said body translation means includes a chain connected at its ends to the ends of the table body and a driven sprocket connected to the power means and engaged with the chain.

7. An X-ray table comprising, a pedestal, a body pivotally supported on the pedestal, tilting means connected to the pedestal and to the body to tilt the body selectively from a horizontal position in a direction to an upright position, translation producing means connected to the body and to the pedestal to shift the body translationally selectively from a central position in a direction to an extreme position, control means for actuating the two mentioned means in their respective directions, said body having a clearance position intermediate the horizontal position and the upright position, said translation means having accomplished at least the greater portion of its total translational movement of the body from the central position to the extreme position prior to the obtainment of the clearance position when the body is tilted from the horizontal position toward the upright position.

8. An X-ray table comprising, a pedestal, a body pivotally supported on the pedestal, tilting means connected to the pedestal and the body to tilt the body selectively from a horizontal position in a selected one of both directions to a selected one of two upright positions, translation producing means connected to the body and to the pedestal to shift the body translationally selectively from a central position in a selected one of two directions to a selected one of two extreme positions, control means for actuating the two mentioned means in the selected

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directions, said body having a pair of clearance positions, each intermediate the horizontal position and one of the upright positions, said translation means having accomplished at least the greater portion of its total translational movement of the body from the central position to the selected extreme position prior to the obtainment of the selected one of the clearance positions when the body is tilted from the horizontal position.

9. The device of claim 8 wherein the body is tilted about 90° from the horizontal position to the selected one of the upright positions and wherein the clearance positions are each not more than 45° from the horizontal.

10. An X-ray table comprising a pedestal, power means carried by the pedestal, a pinion gear drivingly connected to and driven by the power means, a pivot connected to the pedestal, a table body movably carried by the pedestal, a segment of a ring gear connected to the table body and engaged by the pinion, a first spiral sheave journaled on the pedestal and drivingly connected to the said power means, said first sheave being journaled for rotation about an axis parallel to the axis of said pivot, a second spiral sheave journaled for rotation about the axis of the pivot, at least one of said sheaves having a spiral groove of variable diameter, a cable reeved around said sheaves, and a means connected to the second sheave and having spaced ends connected to the body near the ends thereof whereby to shift the body translationally when the sheaves rotate.

11. The device of claim 10 wherein the variable diameter sheave is said first sheave and is connected to the pinion gear.

12. The device of claim 10 wherein the said variable diameter sheave has a central portion of variable pitch and first and second spaced portions on either side of the central portion of substantially constant pitch.

13. An X-ray table comprising, a pedestal having a pivot near the top thereof, a gear segment assembly journaled on the pivot for relative rotation, a table body carried by the assembly, means interposed between the body and the assembly to permit relative rectilinear movement thereof while preventing the relative rotation therebetween, a prime mover connected to the pedestal, a drive shaft journaled in the pedestal, said assembly including a gear segment, a pinion gear connected to the drive shaft and engaged with the gear segment to cause relative rotation of the assembly and the pedestal about the axis of the pivot, a variable diameter sheave connected to the drive shaft, a driven shaft journaled in the pivot in axial alignment therewith, a constant diameter spirally convoluted sheave connected to the driven shaft, a pair of cables connecting the sheaves to cause rotation of the driven sheave upon rotation of the variable pitch sheave and means connected to the driven shaft and to the table body to cause translational movement of the body relative to the pedestal upon rotation of the driven shaft.

14. The device of claim 13 wherein said sheaves are parallel and of substantially equal length having vertically aligned first and second ends and wherein one of the cables is connected to the first end of one sheave and to the second end of the other and wherein the other cable is connected to the second end of the one sheave and the first end of the other.

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