April 18, 1950 O. C. HOLLSTEIN 2,504,687

X-RAY APPARATUS

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Fig. 1.

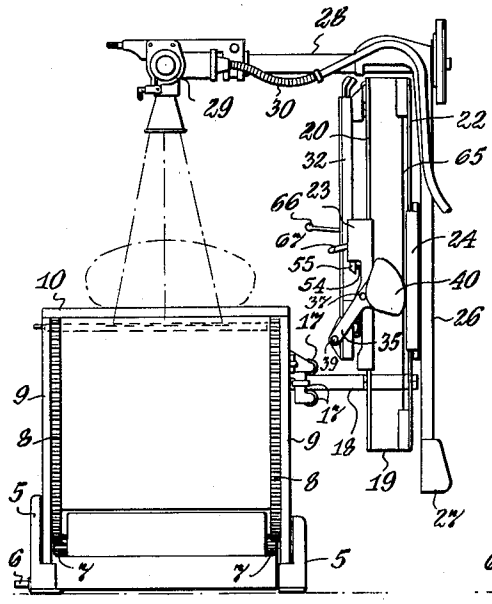


Fig. 2.

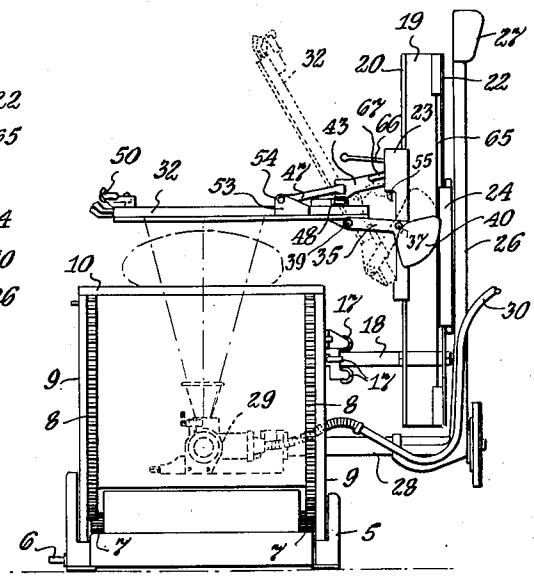
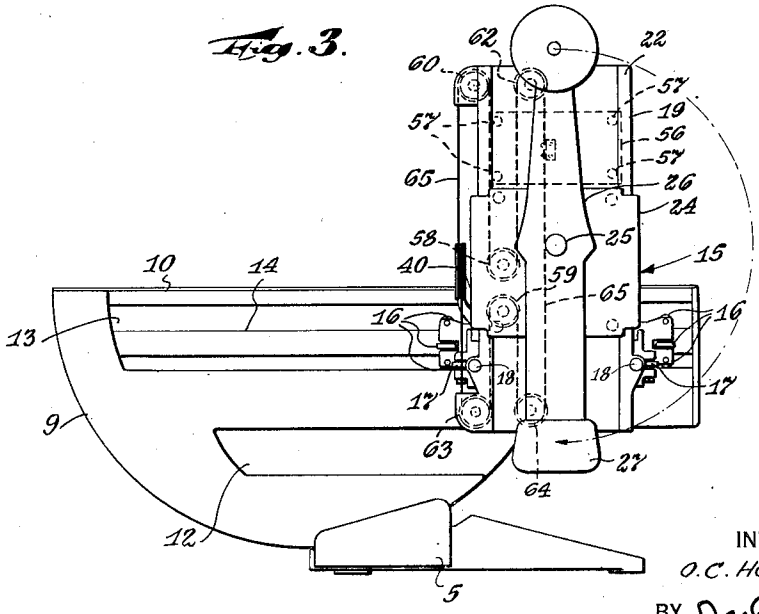


Fig. 3.



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Fig. 4.

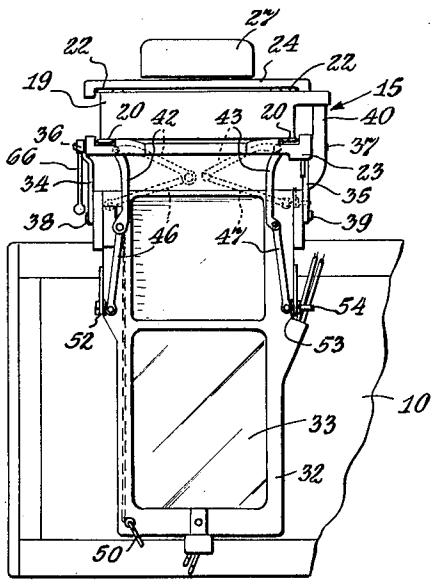


Fig. 5.

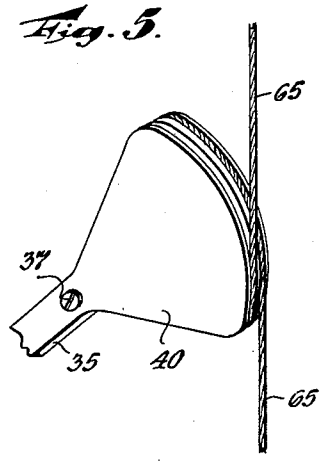
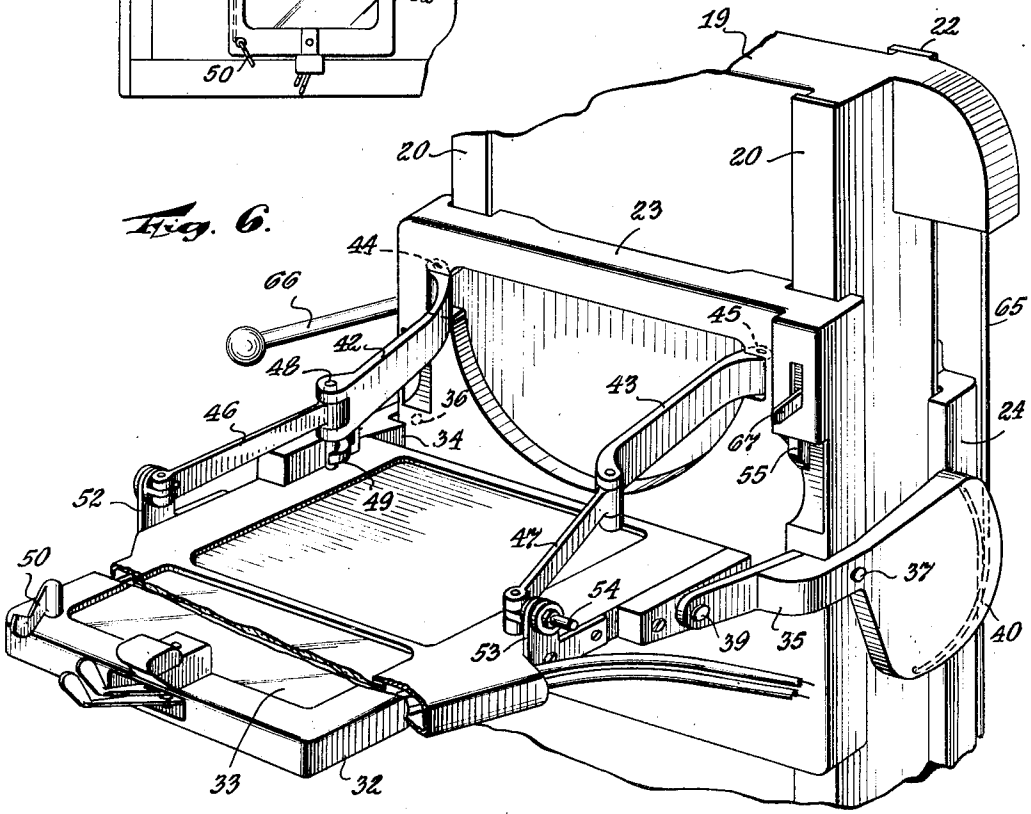


Fig. 6.



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X-RAY APPARATUS

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Fig. 7.

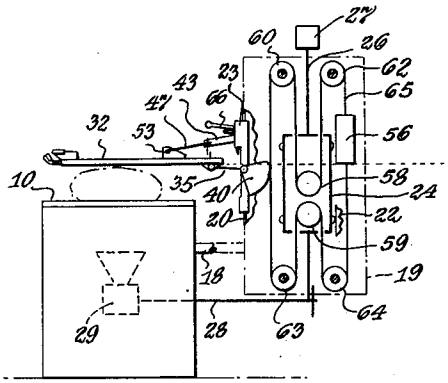


Fig. 8.

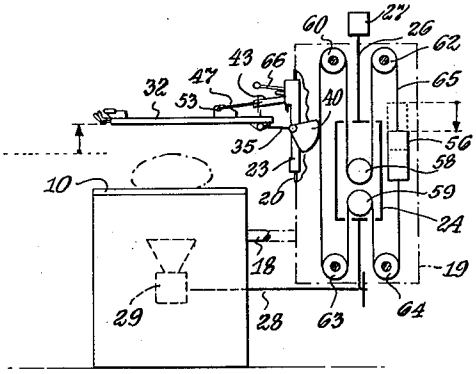


Fig. 9.

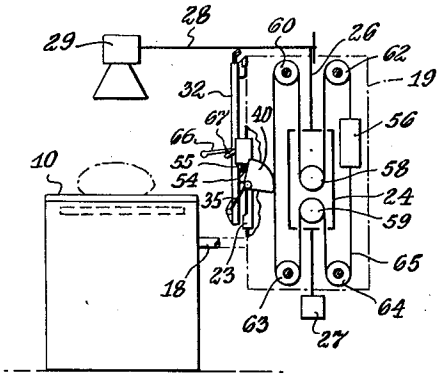


Fig. 10.

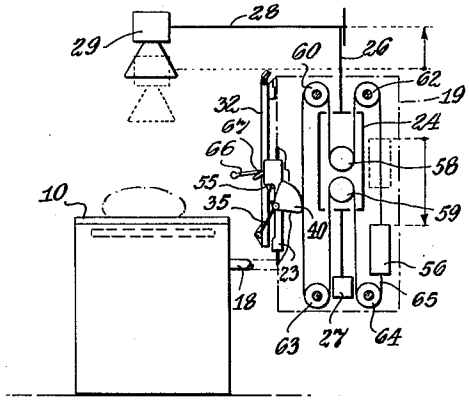


Fig. 11.

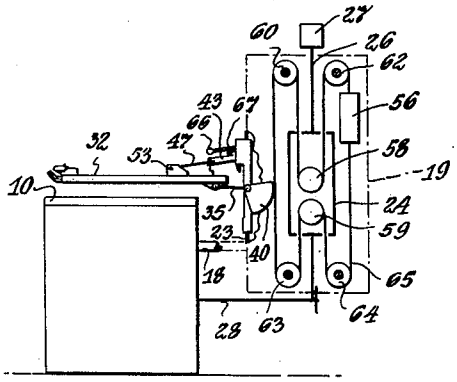
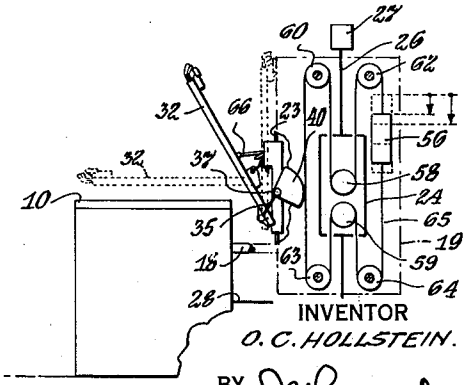


Fig. 12.



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UNITED STATES PATENT OFFICE

2,504,687

X-RAY APPARATUS

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Application April 16, 1947, Serial No. 741,796

9 Claims. (Cl. 250—58)

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The present invention relates to X-ray apparatus and more particularly to X-ray examination tables of the tilting type used by the roentgenologist for the making of radiographic and fluoroscopic examinations.

Tables of this type for enabling a patient, when reclining upon the table, to be moved to various angular positions from below the horizontal, or what is known as the Trendelenberg position, to a vertical position are known to the art. The most familiar type has been that with which two X-ray tubes are employed, with one of these tubes being disposed below the table top and used primarily for fluoroscopy, and the other X-ray tube being carried by a tube column movable upon a rail longitudinally of the table, and suspended above the table top for the primary purpose of radiography.

In order to decrease the floor area formerly required as well as to eliminate the necessity for two X-ray tubes, the more modern design of X-ray examination tables provides for a single X-ray tube which is rotatable about an axis from its support, to positions above or below the table top as conditions require. This latter type apparatus presents many problems and has, heretofore, possessed several disadvantages. For example, when used for fluoroscopy it is necessary that the X-ray tube which, during such examination is disposed below the table top, follow movement of the fluorescent screen with the latter in turn being movable toward and away from the table top. Moreover, it is essential for efficient operation that the X-ray tube and screen be movable in unison substantially the full length of the table to enable the examination of a patient from one extremity to the other. Inasmuch as the various parts are of substantial weight, one of the greatest problems in this type of examination table has been that of counter-balancing the parts to facilitate ease of movement and protection of the patient, with most types counterbalancing the movable parts only when the table is moved to the vertical position.

During the making of a radiographic examination, when the X-ray tube is disposed above the table top, the fluorescent screen constitutes an obstruction which must be moved out of the field and retained safely in such position to prevent accidental contact with the X-ray tube or the patient. A further disadvantage heretofore existent in single tube X-ray examination tables has been the fact that movement of the X-ray tube relative to the table top, both longitudinally and perpendicular thereto, has been considerably

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restricted especially insofar as enabling the X-ray tube to be moved to as short a space as approximately six inches from the table top.

It is accordingly the primary object of the present invention to provide an X-ray examination table of the tilting type wherein a single X-ray tube is employed which is movable to positions both above and below the table top with certain movable parts being counter-balanced in all positions of the table to facilitate ease of movement thereof.

Another object of the present invention is the provision of an X-ray examination table in which the fluorescent screen and X-ray tube support are fully counter-balanced by the same counterweight thus decreasing the size of the equipment which would be otherwise required.

Another object of the present invention is the provision of an X-ray examination table wherein the X-ray tube can be moved to substantially any position above the table top and the fluorescent screen is so counter-balanced as to be automatically moved out of the X-ray field during the making of a radiographic examination.

A further object of the present invention is the provision of an X-ray examination table wherein all the moving parts are counter-balanced by a single counter-weight which decreases the size and weight of the entire apparatus with such counter-weight selectively operating as each part is moved.

Still further objects of the present invention will become obvious to those skilled in the art by reference to the accompanying drawings wherein:

Figure 1 is an end view of the X-ray examination table of the present invention in radiographic position,

Figure 2 is a view similar to Figure 1 but showing a position to which a part of the apparatus is moved for fluoroscopic examination,

Figure 3 is a side view of the X-ray examination table of the present invention as shown in Figure 1,

Figure 4 is a fragmentary top plan view of the table as shown in Figure 2,

Figure 5 is a detail view on an enlarged scale of a part of the apparatus for moving fluorescent screen in accordance with the present invention,

Figure 6 is a fragmentary perspective view of the fluorescent screen and the collapsible supporting arrangement for moving the screen out of the X-ray field during a radiographic examination as shown in Figure 2,

Figure 7 is a schematic view somewhat similar

to Figure 2 and showing the position of the parts and the counter-weight therefore during the making of a fluoroscopic examination.

Figure 8 is a schematic view identical to Figure 7 but showing movement of the counter-weight in response to movement of the fluorescent screen to a new position relative to the table top,

Figure 9 is a schematic view similar to Figure 7 but showing the position of the various parts during the making of a radiographic examination.

Figure 10 is a view identical to Figure 9 but showing movement of the counter-weight in response to movement of the X-ray tube and support relative to the table top during the making of a radiographic examination,

Figure 11 is a view similar to Figure 7 and showing the fluorescent screen in its lowermost position relative to the table top, and

Figure 12 is a schematic view showing movement of the counter-weight in response to collapsing of the fluorescent screen to its fixed position out of the X-ray field preparatory to the making of a radiographic examination.

Referring now to the drawings in detail the X-ray examination table of the present invention is shown as comprising a suitable base 5 which rests upon the floor and carries mechanism for tilting the table top, such for example as an electric motor (not shown). This motor is operated by a foot switch 6 and rotates a shaft which carries a gear 7 at each end meshing with arcuate rack-bars 8 welded or otherwise affixed to sectors 9 and constituting standards for the table top 10. Thus upon operation of the motor, the standards 9 are rotated by the rack-bars 8 about an imaginary pivot as the sectors 9 slide over the base 5.

It will be noted from Figure 3 that the sectors or uprights 9 are provided with horizontal slots 12 and 13, and spaced slightly beneath the table top are a pair of rails or the like 14, upon which a fluoroscopic carriage 15 provided with rollers 16, is arranged to move longitudinally of the table top 10. The carriage 15 is also provided with additional rollers 17 (Figures 1 and 2) engaging a horizontally disposed frame or the like 18, which forms a telescopic connection with that portion of the carriage 15 disposed below the table top 10. Such frame 18 in turn supports a vertically positioned tower or column 19 of channel shape on its front and rear surfaces to form tracks 20 and 22, as shown more clearly in Figure 6.

A fluorescent screen carriage 23 is movable vertically upon the tracks 20 on the front face of the tower 19 while an X-ray tube carriage 24 likewise is vertically movable upon the tracks 22 formed on the rear surface of the tower 19. Pivotally secured to the X-ray tube carriage 24 at 25 is an X-ray tube support assembly which comprises a pivoted member 26 carrying a counter-weight 27 at one end and a horizontally extending arm 28 at its other end. As shown more clearly in Figure 1, this arm 28 carries the X-ray tube housing 29 at its free end and in order to enable rotary motion of the X-ray tube and housing 29 the arm 28 is rotatably secured to the pivoted member 26. The X-ray tube disposed within the housing 29 is supplied with high potential electrical energy through insulated cables 30 extending to a high tension transformer, in the customary manner.

By reference now more particularly to Figure 6, it will be noted that the fluorescent screen carriage 23 is arranged to support a fluorescent screen frame 32, carrying a fluorescent screen 33, through a collapsible toggle connection. Such arrangement comprises a pair of link members 34 and 35 pivoted at 36 and 37 to the carriage 23 and to the fluorescent screen frame 32 at points 38 and 39, with one of these link members 35 having an extension in the form of a sector 40 as shown in Figure 5. A further pair of slightly curved toggle links 42 and 43 are pivoted at 44 and 45 to the carriage 23 and at their opposite ends are pivotally connected to a pair of links 46 and 47, respectively, with the pivot pin 48 being elongated and engageable by a catch 49 operable by a lever 50 carried by the screen frame 32. The opposite ends of these latter links are in turn pivotally connected to a pair of upstanding lugs 52 and 53 secured to the screen frame 32, with the pivot pin 54 passing through the lug 53 being elongated, so as to be engageable by a catch 55 carried by the carriage 23, for retaining the fluorescent screen 33 and frame 32 out of the field of X-rays as hereinafter explained.

In order to counter-balance both the fluorescent screen and frame, as well as the X-ray tube supporting assembly, a counter-weight 56 is vertically movable interiorly of the tower or column 19 upon suitable rollers 57 (Figure 3). As can be seen from Figure 3, as well as from the schematic showing of Figures 7 to 12, a pair of pulleys 58 and 59 are pivotally supported by the X-ray tube carriage 24. A pair of pulleys 60 and 62 are carried adjacent the top of the column 19 and a similar pair of pulleys 63 and 64 are disposed adjacent the bottom of the column 19. A chain or cable 65 extends from the counter-weight 56 around the pulley 64, thence around pulley 59, to pulley 63 and around the latter to the upper edge of the sector 40 to which one end of the cable 65 is connected, as shown in Figure 5. Another end of this cable 65 is connected to the lower edge of the sector 40 and passes upwardly over the pulley 60, around the latter to pulley 58, thence around the upper pulley 62, and downwardly to the counter-weight 56.

By reference to Figures 7 and 8, which show the apparatus in position for the making of a fluoroscopic examination with the X-ray tube 29 disposed below the table top, it will be seen that the fluorescent screen carriage 23 is connected directly to the counter-weight 56. Consequently, as the carriage 23 is moved vertically of the column 19 for a total travel of approximately fifteen inches, the counter-weight 56 also moves a like distance in an opposite direction within the column 19, as shown by the arrows in Figure 8.

Assuming now the roentgenologist desires to make a radiographic exposure, the X-ray tube support 26 is rotated about the pivot 25 to move the X-ray tube 29 from below the table top, as shown in Figures 2, 7, and 8, to a position above the table top as shown in Figures 1, 3, 9 and 10. In order to adjust the tube-to-object distance, the roentgenologist moves the tube relative to the table top which causes vertical movement of the X-ray tube carriage 24 riding on the column 19. As the tube-to-object distance is increased, as shown by the upper arrow in Figure 10, the counter-weight 56 moves vertically within the column 19 in an opposite direction but twice the distance of vertical movement of the X-ray tube 29 relative to the table top, as shown by the lower arrow in Figure 10.

It can thus be seen that the counter-weight 56 follows directly movement of the fluorescent screen carriage 23 and must be sufficient to counter-balance the latter because, during movement of the screen carriage 23, the X-ray tube carriage 24 remains fixed which thus fixes the position of the pulleys 58 and 59 carried by the X-ray tube carriage 24. On the other hand, during movement of the X-ray tube carriage 24 the fluorescent screen carriage 23 remains fixed, as hereinafter pointed out, so that the pulleys 58 and 59 change their position which results in the counter-weight 56 moving twice the distance of movement of the X-ray tube 29 relative to the table top. Moreover, due to such arrangement the X-ray tube carriage and associated parts may be twice as heavy as the fluorescent screen carriage, yet both are perfectly counter-balanced by the same counter-weight 56.

Naturally, in order to make a radiographic examination, it is necessary that the fluorescent screen be out of the field of the X-rays from the X-ray tube 29 when positioned above the table top. Preparatory to rotating the X-ray tube 29 from below the table top, as shown in Figures 2 and 11, to its position above the table top as shown in Figures 1, 9 and 10 and the roentgenologist first operates the lever 50 which thus disengages the catch 49 from elongated pivot pin 48. Upon such disengagement the fluorescent screen frame 32 carrying the fluorescent screen 33 automatically moves to an angular position of about 30° with respect to the tower or column 19, as shown in Figures 2 and 12. Such automatic movement is due also to the counter-balancing by the unitary counter-weight 56 which moves downwardly, a distance such as shown by the shortest arrow in Figure 12. Since the ends of the cable 65 are, as hereinbefore mentioned, connected to opposite edges of the sector 40, this takes up the slack in the cable 65 as the sector moves about its pivot 37, enabling the counter-weight 56 to balance the screen frame 32 in its 30° angular position, even though the fluorescent screen carriage 23 remains stationary on the column 19 due to the lock 66.

Automatic movement of the fluorescent screen frame 32, in response to the counter-balancing as above described to a position of 30° relative to the column 19, occurs by virtue of the rotation of the link members 34 and 35 (the latter including the sector 40) about their respective pivots 36 and 37. This causes a downward thrust on the pivots 38 and 39 which in turn causes rotation of the screen frame 32 about the pivots comprising the lugs 52 and 53. Such movement of the screen frame 32 causes the link arrangement to collapse with the toggle links 42 and 43 moving toward each other about their respective pivots 44 and 45 and carrying with them the links 46 and 47 which are pivoted thereto and to the lugs 52 and 53. Once the frame 32 has automatically moved to its 30° angular position, the operator need then only apply a slight pressure to the frame pushing it into a position parallel to the column 19, where it is then held in such position by the elongated pivot pin 54 passing beneath the catch 55, as shown in Figure 1. In moving the screen frame from its angular position to that parallel with the column 19, the sector 40 again makes the cable 65 taut and the counter-weight 56 moves downwardly a distance represented by the difference between that shown by the shortest and longest arrows in Figure 12.

When it is desired to again return the fluorescent screen frame in position for a fluoroscopic examination parallel to the table top, the operator need only release the latch 55 by raising a handle 67 which causes the latch 55 to slide away from above the pivot pin 54. The screen frame is then pulled away from the column 19 until it again reaches its approximately 30° balanced position at which time the sector 40 will have again taken up the cable slack and raising the counter-weight 56 to a position where it again counter-balances the screen frame 32. From this 30° angular position to the horizontal above the table top, then requires very little force due to complete counter-balancing. Upon release of the lock 66 the carriage 23 is then free to move vertically of the column 19 under full counter-balancing of the counter weight 56 as before explained.

It can thus be seen from the foregoing that an X-ray examination table is herein provided, in which a single radiographic-fluoroscopic assembly is carried by the table with but one X-ray tube being employed, and such X-ray tube is readily movable from a fluoroscopic position below the table top to a radiographic position above the table top, and vice versa. Moreover, a unitary counter-weight is employed for counter-balancing vertical movement of the radiographic elements of the assembly and vertical movement of the fluoroscopic elements thereof, as well as counter-balancing movement of the fluorescent screen frame in an angular position between the horizontal and vertical. Also the fluorescent screen frame carrying the fluorescent screen is supported by toggle link arrangement from the fluorescent screen carriage which facilitates the ease and rapidity with which the screen can be moved into a fixed position perpendicular to the table top and thus out of the field of X-radiations during a radiographic examination.

Although one embodiment of the present invention has been shown and described, it is to be understood that further modifications thereof may be made without departing from the spirit and scope of the appended claims.

I claim:

1. An X-ray examination table comprising a base, a table top rotatable with respect to said base from a position below the horizontal to a vertical position, a carriage movable longitudinally of said table top, a column carried by said carriage and laterally adjustable with respect to said table top, a radiographic assembly provided with an X-ray tube and movable longitudinally along said column to adjust said X-ray tube relative to said table top and including a pivoted member carrying said X-ray tube at one end for swinging said X-ray tube below said table top for a fluoroscopic examination and to a position above said table top for a radiographic examination, a fluoroscopic assembly movable longitudinally along said column independently of said radiographic assembly including a fluorescent screen and frame movable by the operator to a position parallel to said table top during a fluoroscopic examination and to a position perpendicular to said table top during a radiographic examination, and a unitary counter-weight movable longitudinally along said column and connected to said radiographic assembly and said fluoroscopic assembly for counter-balancing both of said assemblies in all longitudinal positions thereof as well as counter-balancing said fluorescent screen and frame in an angular position with respect to said table top.

2. An X-ray examination table comprising a base, a table top rotatable with respect to said base from a position below the horizontal to a vertical position, a carriage movable longitudinally of said table top, a column carried by said carriage and laterally adjustable with respect to said table top, a radiographic assembly provided with an X-ray tube and movable longitudinally along said column to adjust said X-ray tube relative to said table top and including a pivoted member carrying said X-ray tube at one end for swinging said X-ray tube below said table top for a fluoroscopic examination and to a position above said table top for a radiographic examination, a fluoroscopic assembly movable longitudinally along said column independently of said radiographic assembly including a fluorescent screen and frame movable by the operator to a position parallel to said table top during a fluoroscopic examination and to a position perpendicular to said table top during a radiographic examination, and a unitary counter-weight connected to said radiographic assembly and movable longitudinally along said column a distance equal to twice the distance of travel of said radiographic assembly to counter-balance the latter in all its longitudinal positions along said column, said unitary counter-weight being also connected to said fluoroscopic assembly and movable longitudinally along said column a distance equal to the distance of travel of said fluoroscopic assembly to counter-balance the latter in all its vertical positions along said column, and said unitary counter-weight being connected to said fluorescent screen and frame and operable to counter-balancing the same in an angular position with respect to said table top.

3. An X-ray examination table comprising a base, a table top rotatable with respect to said base from a position below the horizontal to a vertical position, a carriage movable longitudinally of said table top, a column carried by said carriage and laterally adjustable with respect to said table top, a radiographic assembly provided with an X-ray tube and movable longitudinally along said column to adjust said X-ray tube relative to said table top and including a pivoted member carrying said X-ray tube at one end for swinging said X-ray tube below said table top for a fluoroscopic examination and to a position above said table top for a radiographic examination, a fluoroscopic assembly movable longitudinally along said column independently of said radiographic assembly including a fluorescent screen and frame movable by the operator to a position parallel to said table top during a fluoroscopic examination and provided with a toggle link arrangement collapsible in the direction of said column in response to operation by an operator to enable said fluorescent screen and frame to be moved to a position perpendicular to said table top during a radiographic examination, and a unitary counter-weight movable longitudinally along said column and connected to said radiographic assembly and said fluoroscopic assembly for counter-balancing both of said assemblies in all longitudinal positions thereof as well as causing movement of said fluorescent screen and frame to a counter-balanced angular position with respect to said table top upon collapse of said toggle arrangement by an operator.

4. An X-ray examination table comprising a base, a table top rotatable with respect to said base from a position below the horizontal to a vertical position, a carriage movable longitudinally of said table top, a column carried by said carriage and laterally adjustable with respect to said table top, a radiographic assembly provided with an X-ray tube and movable longitudinally along said column to adjust said X-ray tube relative to said table top and including a pivoted member carrying said X-ray tube at one end for swinging said X-ray tube below said table top for a fluoroscopic examination and to a position above said table top for a radiographic examination, a fluoroscopic carriage movable longitudinally along said column independently of said radiographic assembly, a fluorescent screen and frame connected to said fluoroscopic carriage by a toggle arrangement including a plurality of pivoted links collapsible in a plane parallel to said table top at the will of an operator to enable said fluorescent screen and frame to automatically move to an angular position and thence moved by the operator to a position perpendicular to said table top during a radiographic examination, and a unitary counter-weight movable longitudinally along said column and connected to said radiographic assembly and said fluoroscopic carriage for counter-balancing said assembly and said carriage in all longitudinal positions thereof as well as counter-balancing said fluorescent screen and frame in an angular position with respect to said table top.

5. An X-ray examination table comprising a base, a table top rotatable with respect to said base from a position below the horizontal to a vertical position, a carriage movable longitudinally of said table top, a column carried by said carriage and laterally adjustable with respect to said table top, a radiographic assembly movable longitudinally on said column and including a pivoted member carrying an X-ray tube at one end for swinging said X-ray tube below said table top for a fluoroscopic examination and to a position above said table top for a radiographic examination, a fluoroscopic carriage movable longitudinally of said column, a fluorescent screen and frame pivotally connected by a pair of brackets to said fluoroscopic carriage, a collapsible toggle arrangement connected to said fluoroscopic carriage and to said fluorescent screen frame comprising a pair of toggle links vertically pivoted to said carriage and to a pair of link members in turn vertically pivoted to said fluorescent screen frame, with said pairs of links being collapsible in a plane parallel to said table top about their respective vertical pivots, to cause rotary movement of said pair of brackets about their pivots accompanied by movement of said fluorescent screen and frame from a position parallel to said table top during a fluoroscopic examination and to a position perpendicular to said table top during a radiographic examination, and a unitary counter-weight movable vertically of said column and connected to said radiographic assembly and said fluoroscopic assembly for counter-balancing said assembly and said carriage in all longitudinal positions thereof as well as counter-balancing said fluorescent screen and frame in an angular position with respect to said table top.

6. A radiographic and fluoroscopic apparatus comprising a column, a radiographic assembly provided with an X-ray tube and movable vertically along said column to adjust said X-ray tube relative to said table top and including a pivoted member supporting said X-ray tube at one end for swinging said X-ray tube to a position below the pivot point of said member for a fluoroscopic examination and above such pivot

point for a radiographic examination, a fluoroscopic assembly movable vertically along said column independently of said radiographic assembly including a fluorescent screen and frame movable by an operator to a horizontal position during a fluoroscopic examination and to a position parallel to said column during a radiographic examination, and a unitary counter-weight movable vertically along said column and connected to said radiographic assembly and said fluoroscopic assembly for counter-balancing both of said assemblies in all vertical positions thereof as well as counter-balancing said fluorescent screen and frame in an angular position between the horizontal and vertical.

7. A radiographic and fluoroscopic apparatus comprising a column, a radiographic assembly provided with an X-ray tube and movable vertically along said column to adjust said X-ray tube relative to said table top and including a pivoted member supporting said X-ray tube at one end for swinging said X-ray tube to a position below the pivot point of said member for a fluoroscopic examination and above such pivot point for a radiographic examination, a fluoroscopic assembly movable vertically along said column independently of said radiographic assembly including a fluorescent screen and frame supported by a collapsible toggle connection including a plurality of pivoted links to said fluoroscopic assembly to enable said fluorescent screen and frame to be moved at the will of an operator to a horizontal position for a fluoroscopic examination and to a vertical position parallel with said column during a radiographic examination, and a unitary counter-weight movable vertically along said column and connected to said radiographic assembly and said fluoroscopic assembly for counter-balancing both said assemblies in all vertical positions thereof as well as counter-balancing said fluorescent screen and frame in an angular position between the horizontal and vertical.

8. A radiographic and fluoroscopic apparatus comprising a column, a radiographic assembly provided with an X-ray tube and movable vertically along said column to adjust said X-ray tube relative to said table top and including a pivoted member supporting said X-ray tube at one end for swinging said X-ray tube to a position below the pivot point of said member for a fluoroscopic examination and above such pivot point for a radiographic examination, a fluoroscopic assembly movable vertically along said column independently of said radiographic assembly including a fluorescent screen and frame supported by a collapsible toggle connection including a plurality of pivoted links to said fluoroscopic assembly to enable said fluorescent screen and frame to be moved at the will of an operator to a horizontal position for a fluoroscopic examination and to a position parallel with said column during a radiographic examination.

9. A radiographic and fluoroscopic apparatus comprising a column, a radiographic assembly movable vertically on said column including a pivoted member supporting an X-ray tube at one end for swinging said X-ray tube to a position below the pivot point of said member for a fluoroscopic examination and above such pivot point for a radiographic examination, a fluoroscopic assembly movable vertically on said column including a carriage, a fluorescent screen and frame pivotally connected by a pair of brackets to said carriage, a collapsible toggle arrangement connected to said fluorescent screen and frame and to said fluoroscopic carriage comprising a pair of toggle links vertically pivoted to said carriage and to a pair of link members in turn vertically pivoted to said fluorescent screen frame, with said pairs of links being collapsible in a horizontal plane about their respective vertical pivots to cause rotary movement of said pair of brackets about their pivots, accompanied by movement of said fluorescent screen and frame from a horizontal position for a fluoroscopic examination to a vertical position parallel with said column during a radiographic examination.

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