Feb. 16, 1943. A. SIMMON 2,311,581

X-RAY APPARATUS

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Fig. 1.

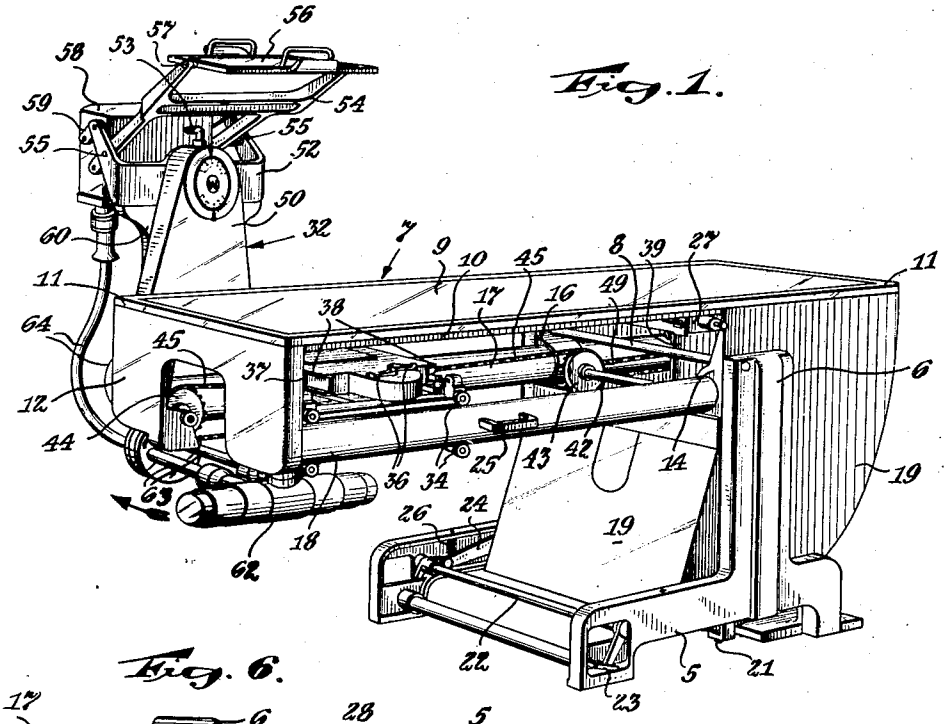
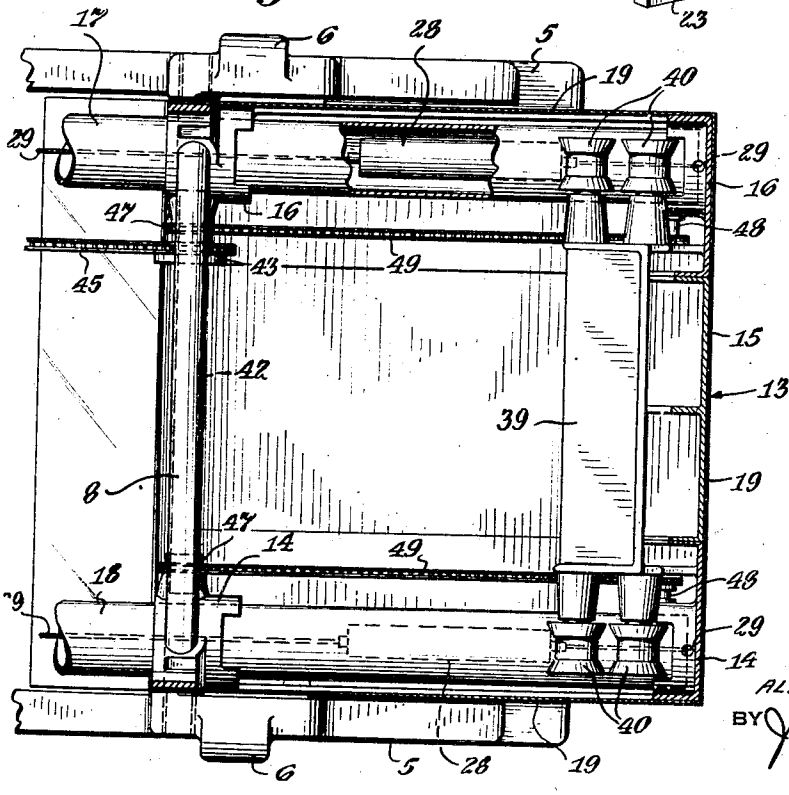


Fig. 6.



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Fig. 2.

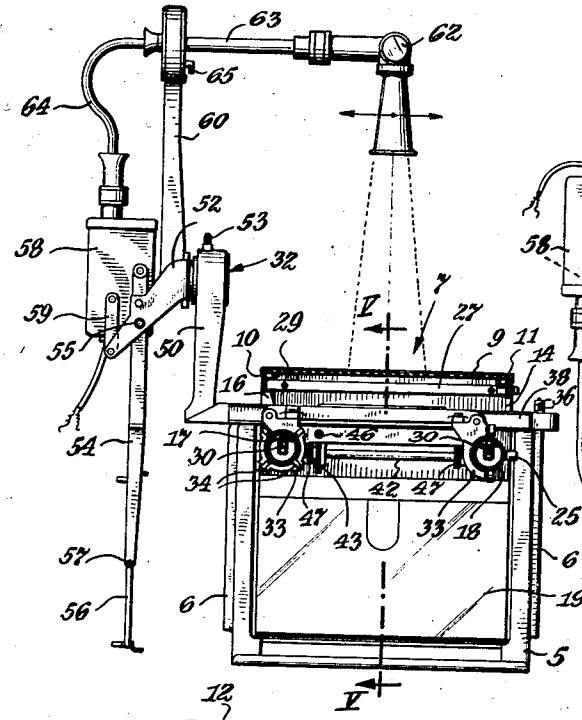


Fig. 3.

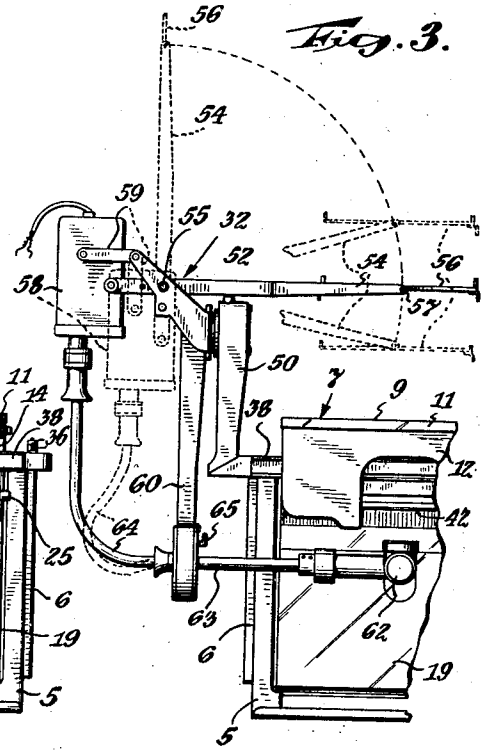
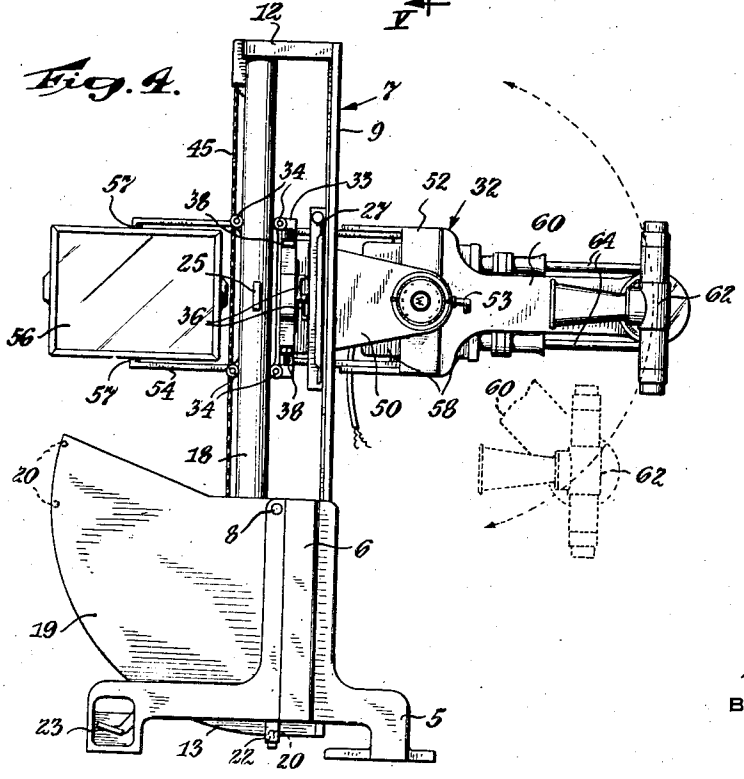


Fig. 4.



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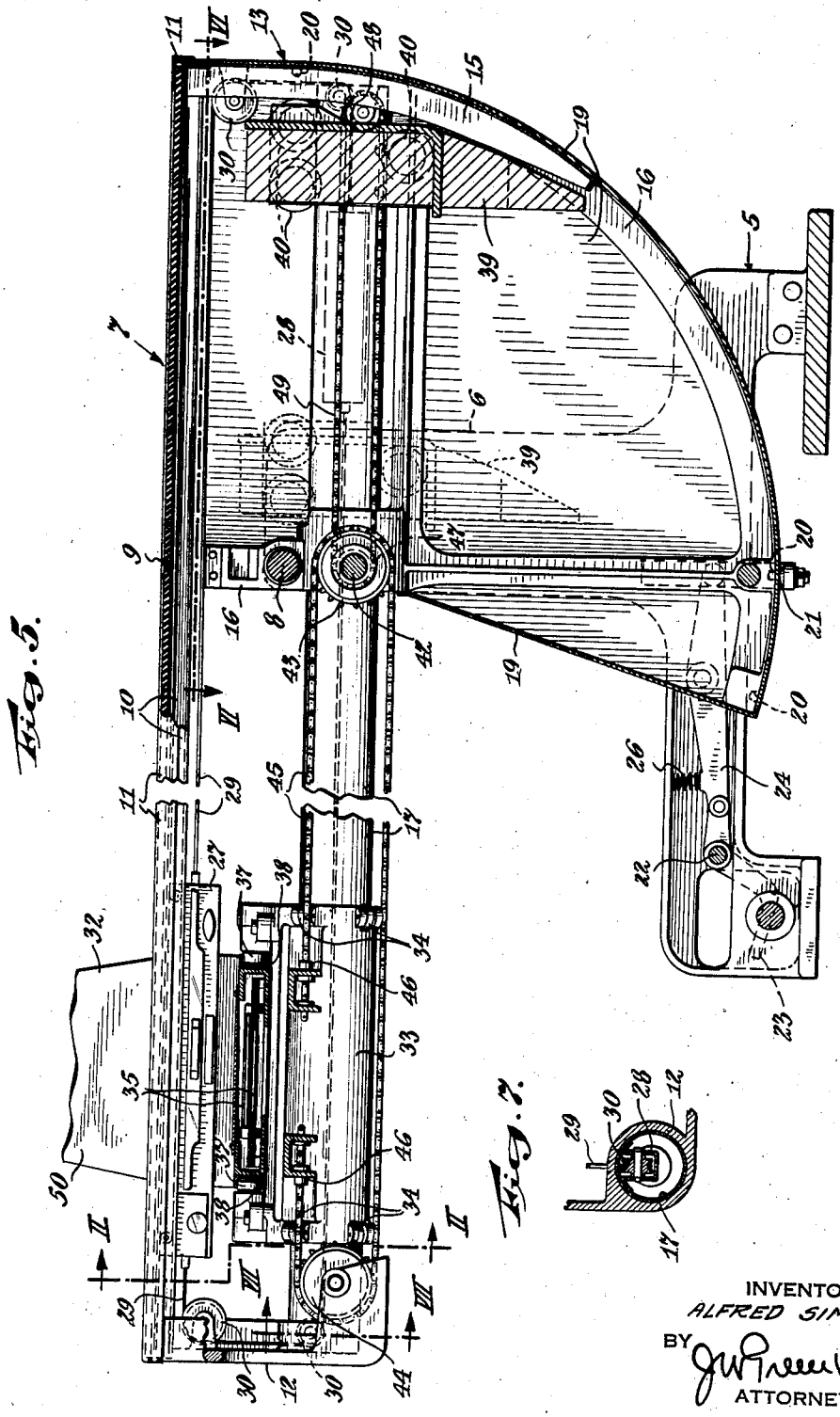


Fig. 5.

Fig. 7.

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UNITED STATES PATENT OFFICE

2,311,581

X-RAY APPARATUS

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Application March 18, 1941, Serial No. 383,897

3 Claims. (Cl. 250—57)

The present invention relates to X-ray apparatus, and more particularly to such apparatus for the making of radiofluoroscopic examinations wherein the apparatus is readily changed at the will of the operator so as to adapt it to fluoroscopy or to the taking of a radiographic exposure.

Apparatus of this type has long been known to the art but has heretofore been of an exceedingly cumbersome nature, thus rendering movement of the various parts somewhat difficult due to inertia caused by their weight.

It is accordingly the primary object of the present invention to provide X-ray apparatus for the making of radiofluoroscopic examinations which is of very simple construction and wherein the various parts can be moved with great facility.

Another object of the present invention is the provision of X-ray apparatus for the making of fluoroscopic examinations and the taking of radiographic exposures wherein the apparatus can be readily positioned from below the horizontal to vertical, and regardless of its particular position the various parts can be moved with great facility to adapt the apparatus to either desired type of examination.

Another object of the present invention is the provision of a fluoroscopic and radiographic carriage movable longitudinally of an examination table which is held in any desired position by a counterbalance and wherein the counterbalance moves only a fraction of the distance of that of the carriage.

A further object of the present invention is the provision of a fluoroscopic and radiographic carriage provided with a counterweighted fluoroscope which simplifies positioning and the changing from radiography to fluoroscopy because of decreased weight, thus facilitating ease of movement in any position of the examination table.

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

Fig. 1 is a perspective view of an X-ray apparatus for the making of radiofluoroscopic examinations constructed in accordance with the present invention.

Fig. 2 is an end view partly in section as taken on the line II—II of Fig. 5 of the X-ray apparatus shown in Fig. 1 showing such apparatus in position for the making of a radiographic exposure.

Fig. 3 is a partial end view of the apparatus shown in Fig. 1 and showing the apparatus in position for a fluoroscopic examination of a patient.

Fig. 4 is a side view of the X-ray apparatus of the present invention as illustrated in Fig. 1 showing the examination table in the vertical position.

Fig. 5 is a sectional view taken on the line V—V of Fig. 2 and looking in the direction indicated by the arrows but on a slightly enlarged scale.

Fig. 6 is a sectional view taken on the line VI—VI of Fig. 5 and looking in the direction indicated by the arrows.

Fig. 7 is a sectional view taken on the line VII—VII of Fig. 5.

Referring now to the drawings in detail, the apparatus shown in Fig. 1 comprises a base **5** provided with a pair of uprights or standards **6** to the upper extremity of which a table top, shown generally at **7**, is pivotally supported by a shaft **8**. The panel top **9** for supporting a patient is formed of Bakelite, plywood, or the like, which is pervious to X-rays and is supported by small channel irons **10** (Fig. 2) and held in place by small angle irons **11**. These small channel irons **10** are in turn secured to end plates **12** and **13** in the form of castings.

The cast end plate **13** is formed in three sections **14**, **15**, and **16**, as can best be seen from Fig. 5, with the two outer sections **14** and **16** constituting quadrants through which the supporting shaft **8** passes and which are held together by the center section **15**. A pair of hollow tubes **17** and **18** are suspended between the cast end plates **12** and **13** for forming a raceway or track for a radiographic and fluoroscopic carriage, as hereinafter more fully described. The various cast sections of the end plate **13** are, as shown, completely concealed by a suitable covering of sheet metal or the like **19**.

For the purpose of positioning the table from the Trendelenberg to the vertical, the casting sections **14** and **16** are provided with a plurality of recesses **20** adapted to be engaged by a detent or pin **21**. When it is desired to move the table top from one position to the other, the operator merely treads upon a foot pedal **23** secured to a shaft **22** which, through a pair of lever arrangements **24**, withdraws each detent **21** and by grasping the handle **25** (Fig. 1), the table is moved to the desired position after which the respective detents **21** again snap into another recess **20** under the action of a pair of coil springs **26** (Fig. 5). Since the shaft **22** extends across

the base 5 and is provided at each end with a foot pedal 23, the table can of course be raised by the operator from either side.

As is customary with radiofluoroscopic X-ray apparatus, a cassette and Bucky grid carriage 27 is provided which is movable longitudinally of the table on the underside of the panel top by a plurality of rollers engaging the small channel irons 10. In order to retain this carriage 27 in any desired position, it is connected to a pair of counterweights 28 movable within the hollow tubes 17 and 18 (see Fig. 7), such connection being effected through a small cable or the like 29 which passes around suitable pulleys 30 journaled to the respective end castings 12 and 13 as well as similar pulleys in the ends of the tubes 17 and 18 (see Fig. 2).

The radiofluoroscopic carriage, shown generally at 32, is formed with a pair of sleeve bearings 33 provided with a plurality of rollers 34 to enable movement of the carriage longitudinally upon the hollow tubes or race-way 17 and 18. As can be more readily seen in Fig. 5, the carriage 32 is provided with the customary fluoroscopic shutters 35 adjustable by suitable levers 36 (Fig. 1), and this carriage is movable transversely of the table top upon rollers 37 carried by the sleeve bearings 33 and engaging transversely extending channels 38.

To maintain the carriage 32 in any desired position longitudinally of the table, particularly when the table is in the vertical position, a suitable counterweight 39 is provided. Such counterweight 39 is also provided with a plurality of rollers 40 (Figs. 5 and 6) to enable it to be moved longitudinally of the hollow tubing or race-way 17 and 18 in unison with movement of the carriage 32. However, in order to conserve space and employ the same race-way for both the carriage and counterweight, a reduction arrangement is provided which enables the counterweight 39 to be moved but a fractional part of the distance travelled by the carriage 32. This reduction arrangement as shown comprises a shaft 42 journaled between the outside sections 14 and 16 of the end casting 13 which is provided with a sprocket gear 43.

As shown more clearly in Fig. 5, a sprocket gear 44 of the same size as the gear 43 is journaled to the end plate 12 and a chain 45 passes around these sprocket gears 43 and 44 and is secured to the carriage 32 by clamps or the like 46. Thus, when the carriage 32 is moved longitudinally of the table upon the hollow tubes or race-way 17 and 18, the chain and sprocket gear 43 cause rotation of the shaft 42. The shaft 42 is also provided with a pair of sprocket gears 47 of a reduced gear ratio, and in the present embodiment the ratio between the gear 43 and gears 47 is 2 to 1.

Suitably journaled to the end plate 13 are sprocket gears 48 of the identical size as the sprocket gears 47. A chain 49 connects each pair of sprocket gears 47 and 48 with the chains 49 being connected to the counterweight 39 by clamps or the like, similar to the manner of connecting the chain 45 to the carriage 32. Accordingly, when the shaft 42 is rotated in the manner previously described by movement of the carriage 32 longitudinally of the table, the sprocket gears 47 also carried by the shaft 42 are rotated; and since these latter sprocket gears are engaged by the respective chains 49 which are connected to the counterweight 39, the latter is also moved longitudinally of the table. However, since the counterweight is connected to the lower portion of the chains 49, the counterweight, although moved simultaneously with the carriage, is moved in the opposite direction. Moreover, since the ratio between the sprocket gear 43 and gears 47 in the embodiment illustrated is 2 to 1, the counterweight 39 is moved only half the distance of that of the carriage 32. This arrangement, therefore, not only conserves considerable space, but also enables the hollow tubes or race-way 17 and 18 to be employed for the movement of both the carriage 32 and counterweight 39.

By reference now more particularly to Figs. 1, 2, and 3, it will be noted that the carriage 32 is provided with a vertically extending member 50 to the extremity of which is pivotally connected a support carrying the requisite elements for the making of a fluoroscopic examination as well as the X-ray tube. This support comprises a bifurcated yoke 52 rotatable, as before mentioned, about a pivot point formed at the extremity of the vertically extending member with such yoke being held in any desired radial position by means of a lock or the like 53. A bifurcated frame member 54 is pivotally connected at 55 to the parallel arms of the yoke member 52, and a fluorescent screen 56 is in turn pivoted at 57 to the extremities of the arms of the frame 54.

In order to form a counterbalance for the frame 54 and fluorescent screen 56, the high voltage transformer 58 is connected to the opposite extremities of the bifurcated frame member 54 to which the fluorescent screen 56 is connected. Thus, the screen frame 54 is pivotally connected not only to the yoke member 52, but also to the high voltage transformer 58. In addition, a pair of link members 59 are pivotally connected to the transformer 58 and to the extremities of the yoke member 52. The yoke member 52 is also formed with an integral projection 60 extending in a vertical plane which supports in a shock-proof manner an X-ray tube 62. The projection 60 at its extremity is provided with a bearing rotatable therein and to which the X-ray tube supporting arms 63 are secured.

As will be noted more particularly in Figs. 2 and 3, a pair of insulated high voltage cables 64 extend from the high voltage transformer 58 through the X-ray tube supporting arms 63 and accordingly through the vertical projection 60. This arrangement allows rotation of the X-ray tube supporting arms 63 about a pivot point formed in the extremity of the vertical projection 60 without entanglement of the high voltage cables 64 with the X-ray tube being held at any desired angle by means of a lock 65.

The fluoroscopic carriage 32 is thus readily adaptable to the making of a fluoroscopic examination or the taking of a radiographic exposure. With the apparatus in the position shown in Figs. 1 and 3, the X-ray tube 62 is positioned on the underside of the table top and the fluorescent screen 56 above the table. Since the carriage 32 is movable both longitudinally and transversely of the table top, the roentgenologist can locate the fluorescent screen 56 and X-ray tube 62 in alignment with any portion of a patient's body it is desired to examine. Also, the fluorescent screen can be moved into close proximity to the body of a patient since the screen 56 is not only movable about the pivot 57 formed with the screen frame 54, but in addition the screen frame 54 is likewise movable about the pivot 55. When the screen frame 54 is moved about this latter pivot 55, the high voltage transformer 58 is raised

or lowered due to the pivotal connection of the screen frame **54** therewith, as well as because of the link arrangement **59** between the high voltage transformer and yoke member **52**. Accordingly, the high voltage transformer **58** functions as a counterbalance for the screen frame **54** and screen **56**, maintaining the screen **56** in any desired position. The X-ray tube is accordingly energized and an image cast upon the fluorescent screen.

Assuming now it is desired to take a radiographic exposure with the patient still in a horizontal position, the fluorescent screen frame **54**, together with its pivotally connected fluorescent screen **56**, is moved to a vertical position as shown in the dotted lines of Fig. 3. At the same time the screen frame **54** is moved to the vertical position, the high voltage transformer **58** is likewise shifted in the manner shown by the dotted lines in Fig. 3. The carriage **32** is then moved to the end of the table top with the screen and tube being rotated about the pivotal connection of the yoke member **52** with the vertically extending member **50**.

The X-ray tube **62** accordingly swings through an arc in the direction shown by the arrow in Fig. 1, passing out from under the table through an opening provided in the end plate **12**, as shown in Fig. 1, and at the same time the fluorescent screen frame **54** and **56** are swung downwardly so that the X-ray tube **62** is then positioned above the table top in the manner shown in Fig. 2 with the fluorescent screen, although positioned below the table top, being maintained in a vertical plane. This accordingly enables the X-ray tube **62** to be energized with the X-rays passing through the body of the patient, and an image thereof recorded on a sensitized film housed within the cassette carried by the carriage **27** disposed below the table top.

Again it will be noted that with the X-ray tube **62** now positioned above the table top, the transformer **58** still operates as a counterweight for the assembly. It should also be noted that irrespective of whether the fluoroscopic carriage **32** be in the position shown in Fig. 2 or Fig. 3, the entire table top which supports the carriage **32** can be rotated about its pivot point formed by the shaft **8** to a position as shown in Fig. 4.

Accordingly, the high voltage transformer **58** serves not only the purpose of supplying electrical energy to the X-ray tube **62**, but also because of the manner in which it is supported, as above described, it serves the additional purpose of counterbalancing the fluoroscope, which simplifies positioning and the changing from radiography to fluoroscopy due to the facility with which such change can be made, regardless of the position of the table, and also results in appreciable reduction of weight. Also, the apparatus is entirely shockproof so that the danger of accidental shock to a patient is entirely eliminated, and since there is no mechanical strain on the insulated high voltage cables which would otherwise occur due to twisting or kinking, such hazard cannot arise.

It is accordingly obvious to those skilled in the art that a radiofluoroscopic apparatus is herein provided which is of exceptionally simple yet efficient and rugged design. Moreover, since the high voltage transformer which is essential to the operation of the apparatus is employed for the additional purpose of a counterweight, the entire weight of the apparatus is thus materially reduced without sacrifice of ease of manipulation. To further conserve space, the fluoroscopic carriage is counterbalanced through a reduction arrangement which enables the counterweights for the carriage to be moved but a fractional part of the distance traveled by the carriage, and also enables the utilization of the same race-way for movement of both the carriage and its counterweight.

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

I claim:

1. A radiographic carriage for X-ray apparatus comprising a support pivotally connected to said carriage, an X-ray tube assembly pivotally connected to the extremity of said pivoted support, a fluorescent screen frame pivotally connected to said support and having a fluorescent screen pivotally connected thereto, and an electric transformer for supplying electrical energy to said X-ray tube pivotally connected to said fluorescent screen frame to form a counterweight for said frame and the fluorescent screen carried thereby in all positions thereof about its pivot and movable with said fluorescent screen and X-ray tube assembly about the pivotal connection of said support to said carriage.

2. A radiographic carriage for X-ray apparatus comprising a support pivotally connected to said carriage, an X-ray tube assembly pivotally connected to the extremity of said pivoted support, a fluorescent screen frame pivotally connected to said support and having a fluorescent screen pivotally connected thereto, and an electric transformer for supplying electrical energy to said X-ray tube pivotally connected to both said support and said fluorescent screen frame to form a counterweight for said fluorescent screen and frame and to maintain said transformer in a preselected position and movable with said fluorescent screen and X-ray tube assembly about the pivotal connection of said support to said carriage.

3. A radiographic carriage for X-ray apparatus adapted to be moved longitudinally and transversely of an examination table comprising a support pivotally connected to said carriage, an X-ray tube assembly pivotally connected to the extremity of said pivoted support, a fluorescent screen frame pivotally connected to said support for movement in a plane at right angles to the plane of movement of said support and having a fluorescent screen pivotally connected thereto, and an electric transformer for supplying electrical energy to said X-ray tube pivotally connected to both said support and said fluorescent screen frame to form a counterweight for said fluorescent screen frame and the fluorescent screen carried thereby in all positions about its pivot and to maintain said transformer in a preselected position.

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