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2,835,824

X-RAY APPARATUS

Filed June 26, 1956

2 Sheets-Sheet 1

*Fig. 1.*

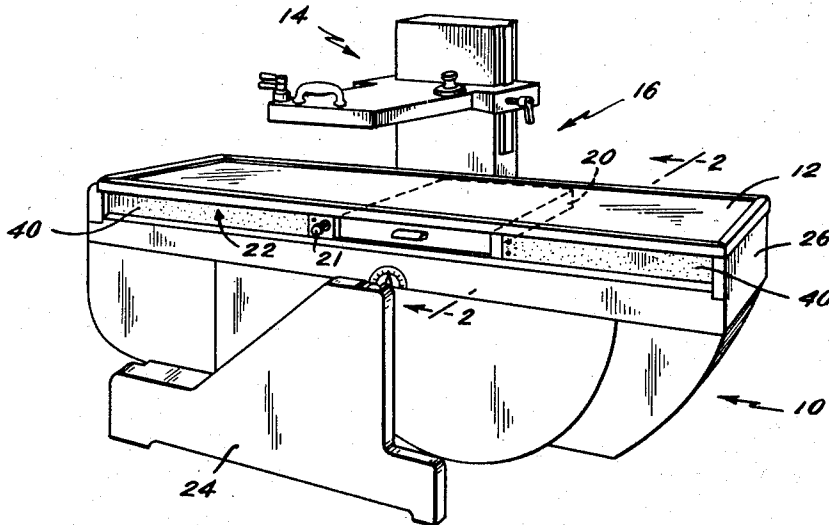
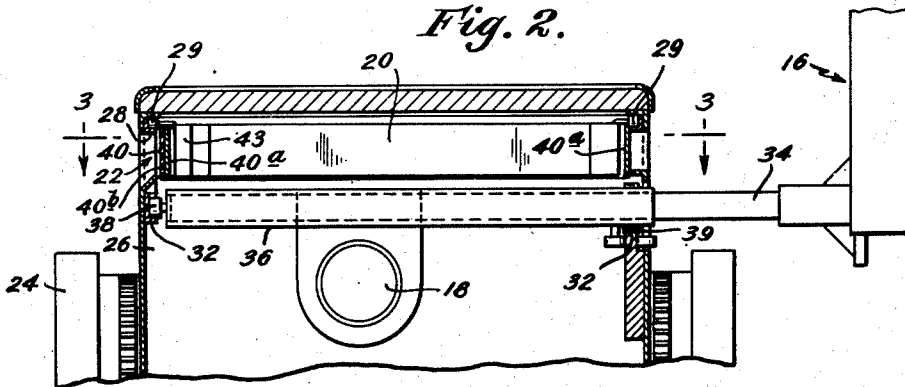


*Fig. 2.*



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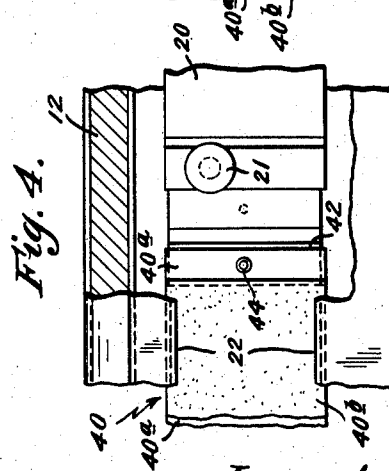
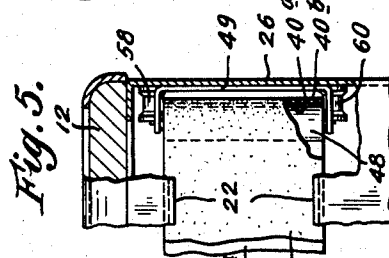
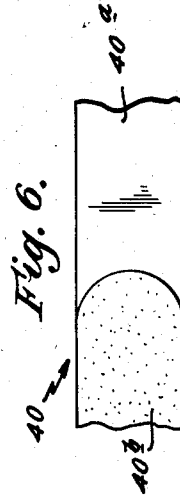
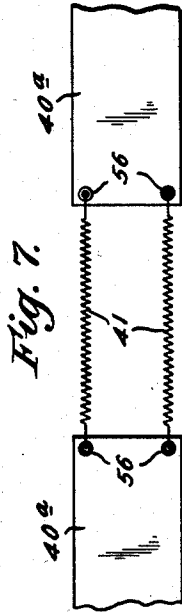
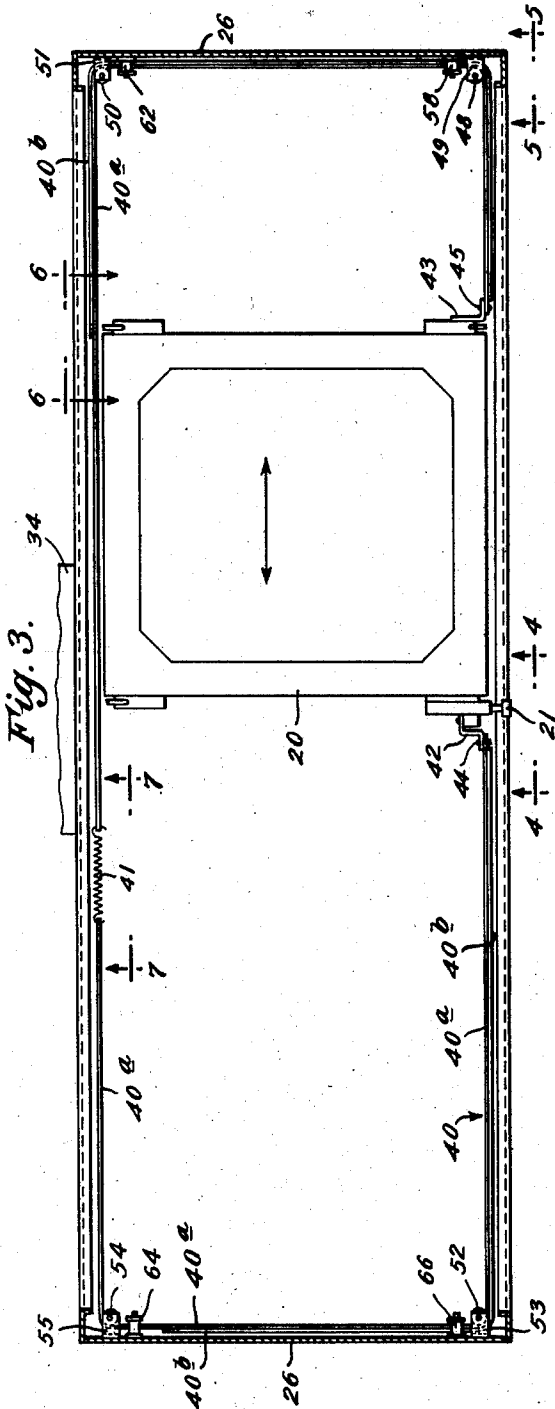
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X-RAY APPARATUS

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2 Sheets-Sheet 2



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2,835,824

## X-RAY APPARATUS

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Application June 26, 1956, Serial No. 593,934

4 Claims. (Cl. 250—108)

This invention relates in general to X-ray apparatus, and more particularly to an improved table structure for the support of a patient for X-ray examination and photography.

X-ray examination may be accomplished by means of a suitable X-ray source mounted in position above the table top to direct an X-ray beam downwardly through the top panel and the patient disposed thereon for examination, to obtain an X-ray picture of the body on X-ray sensitive material supported beneath the panel. Examination may also be accomplished by means of a suitable X-ray source mounted beneath the panel and the patient disposed thereon for examination, for X-ray photography or fluoroscopy on suitable X-ray sensitive material disposed above the patient being examined.

For convenience and flexibility, the table is preferably arranged to allow for examination at will by either of the described methods, and thus may include an X-ray source disposable at will above or below the table top; or separate X-ray sources, one above the table and one below. It is desirable also that the X-ray source or sources be adjustable longitudinally and laterally of the table top within the area thereof, and normally carriage means are provided to allow lateral and longitudinal adjustment of the sensitive material so as to be in fixed relation with respect to the cooperating source of X-rays. The structure may include a carriage mounted on the table frame for movement longitudinally thereof beneath the table top panel, for supporting a cassette to cooperate with an X-ray source above the table. The carriage may also include a Bucky type diaphragm and means for reciprocating the same. Such carriage is normally mounted on suitable rails on the table frame, and may be shifted and locked in adjusted position and otherwise controlled by means of a handle extending outwardly of the table top panel, through a suitable elongated slot immediately beneath the edge of the panel so as to be conveniently located at approximately table top height in position readily accessible to an operator standing beside the table structure.

A separate, longitudinally movable frame structure may be provided for carrying a tunnel above the table top panel, and preferably also includes supporting portions extending beneath the top panel for the mounting of an X-ray source beneath the table in position registering with the sensitive material carried by the tunnel.

In order to avoid interference, the separate carriage structures should be independently movable from one end of the table to the other, and it will be apparent that when one of the structures is in position for examination, the other should be offset therefrom to avoid its interfering with one with which the examination is being conducted. It will be noted that when the tunnel is in use, the under-table X-ray source will be activated to direct X-rays upwardly through the table top and patient upon the sensitive material carried by the tunnel. The operator must necessarily stand alongside the table, to view a fluoroscopic screen, or operate controls, and when

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so standing his midsection is likely to be disposed at the slot provided for the accommodation of the controls for the under-table carriage, in position to be exposed to stray X-ray radiation from the under-table source.

Since it is important to protect the operator from exposure to radiation, the present invention has for its primary object the provision of simple and inexpensive means for minimizing the passage of X-rays through the aforesaid slot whenever the under-table X-ray source is in operation.

Another object of the invention is to arrange such slot shielding means to automatically assume shielding position when the tunnel is in use, without requiring any attention of the operator.

Another object is to provide slot shielding means which will automatically and uniformly be positioned in slot shielding position as the result of moving the under-table carriage to any position intermediate the ends of the table to allow the tunnel to be placed in operation.

Another object is to provide screening means of the character mentioned which require only a small area at the peripheral edges of the table top for their support and positioning in shielding position so as not to interfere with other apparatus supported beneath the table top.

Another object is to provide shielding means comprising a flexible tape of material relatively impervious to X-rays, connected at its opposite ends to opposite front corners of the under-table carriage and extending over sheaves mounted at the four corners of the table frame, so that said tape is at all times disposed in screening position across the slot regardless of the position of the under-table carriage.

Other objects, features and advantages of the invention will become apparent as the same is more fully understood from the following description, taken in connection with the accompanying drawings, in which:

Fig. 1 is a perspective view of an X-ray table embodying the present invention;

Fig. 2 is a sectional view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a somewhat diagrammatic sectional view taken along line 3—3 of Fig. 2, to illustrate the location and action of the shielding means;

Fig. 4 is a fragmentary view, partially in section, of a portion of the under-table carriage of Fig. 3 to illustrate the attachment of the shielding means thereto;

Fig. 5 is a fragmentary view, partially in section, of a portion of the table structure of Fig. 3 to illustrate the mounting thereon of the shielding means;

Fig. 6 is a fragmentary view of a portion of the shielding means of Fig. 3; and

Fig. 7 is a fragmentary view of another portion of the shielding means of Fig. 3.

To illustrate the invention the drawings, particularly Figs. 1 and 2, show an X-ray table adapted for fluoroscopic examination and radiography purposes, comprising a table like structure 10 provided with a top panel 12 of Bakelite or other satisfactory material suitably permeable to X-rays on which a patient to be examined may be positioned. The transverse and side members depending from the top are preferably formed of heavy gauge sheet metal, such as steel, to provide shielding for X-rays originating from the under-table sources. For fluoroscopic examination, a fluoroscopic screen indicated generally by the reference character 14, and which may be of conventional construction, is shown as attached to the table by a suitable mounting mechanism 16 providing for free adjustment of the screen vertically and laterally of the table, and also preferably permitting the screen to be swung out of line with the table to allow free access to a patient on the table top. An X-ray source 18 is disposed beneath the table top in a position

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to emit a beam of X-rays in a direction upwardly through panel 12, the support therefor being attached to supporting mechanism 16 to provide movement of source 18 in synchronism with lateral movements of screen 14.

The table may be used for radiographic purposes, that is, the making of X-ray photographs of an object thereon, by means of an X-ray source (not shown) disposed above the table in conjunction with a cassette and Bucky type diaphragm supported on a carriage 20 for movement longitudinally of the table. To permit such longitudinal movement, and to afford access to the control handle 21 of the carriage, the front of the table is provided with a generally rectangular slot or opening 22 just below the table top and extending substantially the entire length of the table. The handle 21 may be arranged for manual operation to clamp or lock the carriage 20 in any longitudinal adjustment on the table frame.

The illustrated table includes a pedestal or base 24 on which the table frame 26 may be tiltably mounted to support the object under examination in either horizontal or in any tilted position. The present invention is not necessarily limited to a tiltable table structure, but may be incorporated to advantage in a stationary table, if desired. Where a tilting table is employed, however, the same may comprise a structure similar to that illustrated in United States Letters Patent No. 2,534,623, issued December 19, 1950, on the invention of Franklin A. Pitts and Walter H. Haupt. In such structure, the frame 26 may be provided with tracks 28 along the opposite sides of and beneath the top panel 12 for guiding and supporting the carriage 20 for longitudinal movement immediately below the top panel, the carriage being provided with suitable rollers 29 having engagement with tracks 28. The carriage is preferably connected with counterbalancing weights, through suitable cords operating on sheaves on the table frame, to counterbalance the weight of the carriage and facilitate its movement along the tracks, regardless of the attitude of the table. The carriage 20 includes a cassette containing sheet film, the cassette being loaded into the carriage by insertion edgewise through the slot 22. The carriage 20 may also embody a Bucky diaphragm structure positioned between the cassette and the table top, and suitable means for shifting the diaphragm.

The frame 26 may also be provided with tracks 32, below the tracks 28, for supporting the tunnel structure 14, 16 for movement longitudinally of the table frame. To this end, mounting 16 may be secured to a pair of members 34 (one of which is shown), which in turn are telescopically supported on a carriage including a pair of members 36 provided with rollers 38 and 39 adapted to ride the tracks 32 between the opposite ends of the table. The X-ray source 18 is supported on a frame secured to members 34, and is therefore movable transversely of the table always in register with the tunnel 14.

When the structure 14 and X-ray source 18 are to be used for fluoroscopic examination, it will be apparent that carriage 20 will be necessarily be disposed at one end of the table or the other to leave the remaining portions of the table unobstructed. It will be seen that during such examination the operator must stand alongside of the table opposite the viewing screen 14. In such position, the technician's mid-section will necessarily be disposed opposite the slot 22, in line with X-ray source 18, and thus exposed to undesirable stray radiation as may emanate through the opening 22. The slot is of substantial width, about three inches, and must be unobstructed to permit free movement of carriage 20 to any position intermediate the ends of the table, and to permit the cassette to be readily loaded and unloaded.

In accordance with the present invention, shielding means in the form of a tape 40 formed of flexible material capable of absorbing substantially all of such sec-

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ondary radiation is provided, which not only places an adequate shield across the slot 22 whenever the under-table X-ray source is in operation, but also allows free and unobstructed movement at all times of under-table carriage 20. The shielding means is of very simple and inexpensive character, is readily adapted to X-ray tables of different designs without the requirement of material changes in the design of the tables, and completely frees the area immediately beneath the top panel 12 for other apparatus.

The shielding means comprises a tape 40 formed of X-ray shielding material, having a width somewhat greater than the width of slot 22, and sufficiently flexible to be bent and guided around a right-angled corner. The tape 40 may be formed of two similar pieces, corresponding ends of which are secured to opposite front corners of under-table carriage 20, with the corresponding other ends secured together at the rear of the table by a pair of springs 41. Each of the two pieces of tape 40 (exaggerated in the drawings for clarity) is preferably formed of a thin strip, e. g., .005 inch, of flexible spring steel 40a of a length sufficient to extend from the point of attachment to carriage 20 halfway around table frame 26 to springs 41, to the front face of which is cemented, at least over that portion of its length which may be opposite slot 22, a thin strip, e. g.,  $\frac{1}{32}$  inch, of leaded rubber 40b, or the like, of equal width. It will, of course, be understood that the leaded rubber 40b may extend over the entire length of steel tape 40a, if desired, or other satisfactory flexible shielding material substituted for the steel and rubber without departing from the spirit of the invention.

It will be appreciated that carriage 20 shields that portion of slot 22 which it occupies, and accordingly tape 40 is attached to the front corners of the carriage as shown generally in Fig. 3, and in more detail in Fig. 4. Tape 40 is preferably secured to carriage 20 so as to lie in the same vertical plane as the front surface of carriage 20, L-shaped brackets 42 and 43, secured to the carriage as shown being suitable, with the free ends of tape 40 secured thereto by screws 44 and 45, respectively. As best seen in Fig. 3, the two sections of the tape 40 extend in opposite directions from carriage 20 along slot 22, the one to the right extending over a pair of self-aligning sheaves 48 and 50, respectively vertically journaled on brackets 49 and 51 secured to the right end of frame 26, and the one to the left extending over sheaves 52 and 54 journaled on brackets 53 and 55 secured to the left end of frame 26. The two sections are joined together at the rear of the table, outside the line of travel of carriage 20, by a pair of springs 41, secured to eyelets 56 in steel tape 40a, the springs being in sufficient tension to maintain tape 40 taut throughout its length. To prevent sagging of tape 40 and to insure smooth travel over sheaves 48, 50, 52 and 54, a pair of rollers are mounted on the end frame 26 adjacent each sheave for rotation about horizontal axes and spaced apart a distance so as to respectively engage the upper and lower edges of tape 40. As best seen in Fig. 5, which is a fragmentary view of the front right corner of Fig. 3 the rollers 58 and 60 have grooves in their peripheries of sufficient width to engage the edges of tape 40 as the bend is made around sheave 48. Only the upper one of the pair of rollers at the other corners of the table are shown in Fig. 3, being designated by numerals 62, 64 and 66. As shown in Figs. 4 and 5, tape 40 is of such width, and the sheaves are so disposed relative to slot 22, that the tape extends slightly beyond the edges of the slot thoroughly to shield the same.

It will be apparent that as carriage 20 is moved to the right end of the table, for example, tape 40 is driven over sheaves 48, 50, 52 and 54, (and their associated guide rollers) with springs 41 assuming a position near the left rear corner of the table, slot 22 being occupied at all times by the composite steel and leaded rubber

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tape 40. Similarly, as carriage 20 is adjusted to a position near the left end of the table, springs 41 are driven to a position near the right rear corner of the table. Thus, the shielding curtain is always in position, regardless of the position of carriage 20, and without requiring the attention of the operator, it being understood that carriage 20 itself provides shielding for that portion of the slot which it occupies.

While the form of apparatus described above constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In an X-ray table including a generally rectangular frame and a top panel, an under-panel carriage movable on said frame longitudinally of and beneath said panel between opposite ends of said table, and an X-ray source disposed beneath said panel and movable on said frame longitudinally between the ends of said table, wherein the table is formed with an elongated opening beneath the panel affording access to said under-panel carriage in any adjusted position thereof, shielding means comprising X-ray opaque continuous tape means connected at its free ends to said carriage, and tape guiding means secured at the corners of said frame, said tape extending over said tape-guiding means and movable thereover in response to movement of said carriage into position to shield the said opening.

2. In an X-ray table including a generally rectangular frame and a top panel, an under-panel carriage movable on said frame longitudinally of and beneath said panel between opposite ends of said table, and an X-ray source disposed beneath said panel and movable on said frame longitudinally between the ends of said table, wherein the table is formed with an elongated opening beneath the panel affording access to said under-panel carriage in any adjusted position thereof, shielding means comprising a continuous flexible tape formed of X-ray opaque material, tape-guiding sheaves each journaled on a vertical axis at the corners of said frame, said tape extending over said sheaves and connected at its free ends to said carriage and movable thereover in response to movement of said carriage into position to shield the said opening.

3. In an X-ray table including a generally rectangular frame and a top panel, an under-panel carriage movable

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on said frame longitudinally of and beneath said panel between opposite ends of said table, and an X-ray source disposed beneath said panel and movable on said frame longitudinally between the ends of said table, wherein the table is formed with an elongated opening beneath the panel affording access to said under-panel carriage in any adjusted position thereof, X-ray opaque shield means for said opening comprising, two sections of flexible tape formed of X-ray opaque material joined together by spring means, four tape-guiding sheaves each vertically journaled at the corners of said frame, said tape being mounted on said frame with said spring means disposed along the edge of the table opposite said opening and extending over said sheaves and connected at its free ends to said carriage, whereby said tape is movable over said sheaves in response to movement of said carriage into position to shield the said opening.

4. In an X-ray table including a generally rectangular frame and a top panel, an under-panel carriage movable on said frame longitudinally of and beneath said panel between opposite ends of said table, and an X-ray source disposed beneath said panel and movable on said frame longitudinally between the ends of said table, wherein the table is formed with an elongated opening beneath the panel affording access to said under-panel carriage in any adjusted position thereof, X-ray opaque shield means for said opening comprising, two sections of flexible steel tape having cemented thereto thin strips of leaded rubber joined together at corresponding ends by a pair of springs, four sheaves respectively vertically journaled at the corners of said frame substantially in the plane of said elongated opening, a pair of grooved rollers secured to said frame adjacent each of said sheaves for rotation about horizontal axes vertically spaced apart the width of said tape, said tape being mounted on said frame with said springs disposed along the edge thereof opposite said opening and extending over said sheaves and rollers and connected at its free ends to the corners of said carriage adjacent said opening, whereby said tape is movable over said sheaves and rollers in response to movement of said carriage into position to shield the said opening.

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