May 2, 1933. J. F. FORST 1,907,054

X-RAY APPARATUS

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Fig. 8

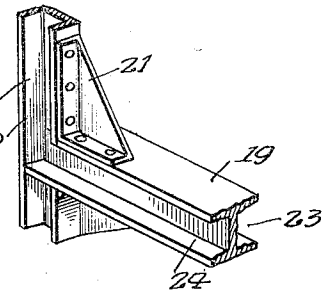


Fig. 5

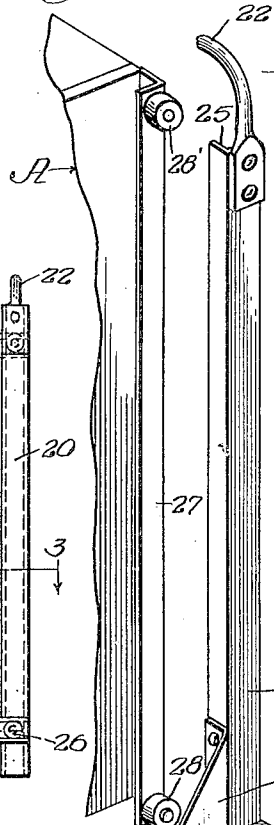


Fig. 6

Fig. 1

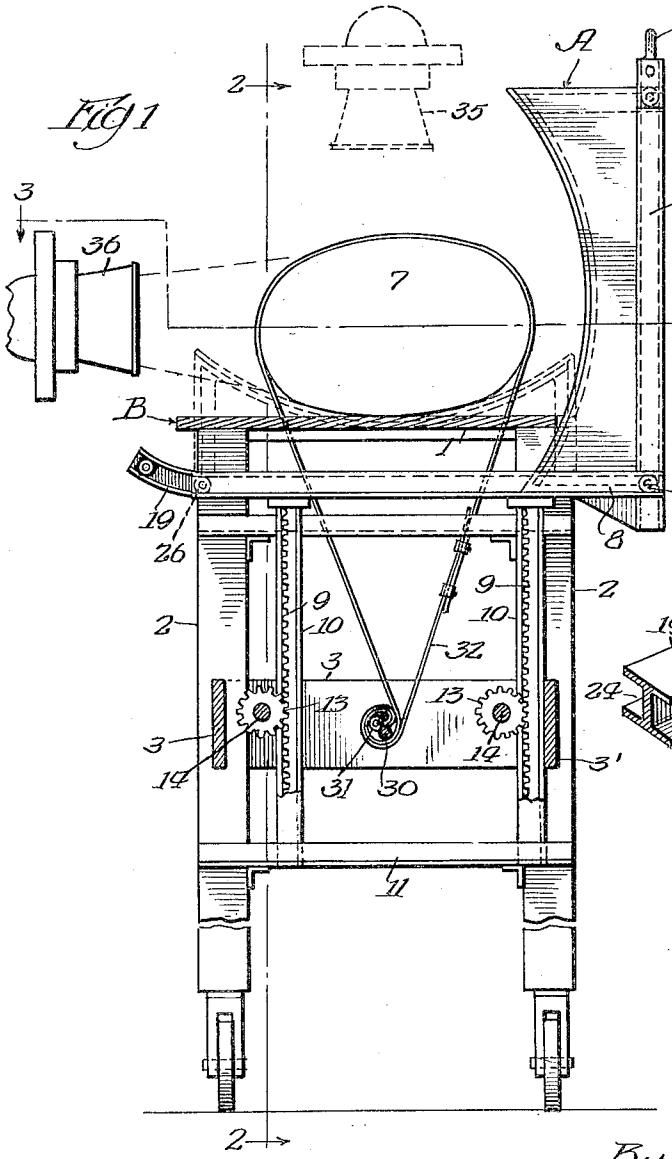
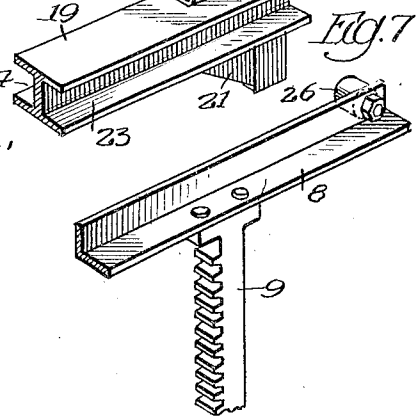


Fig. 7



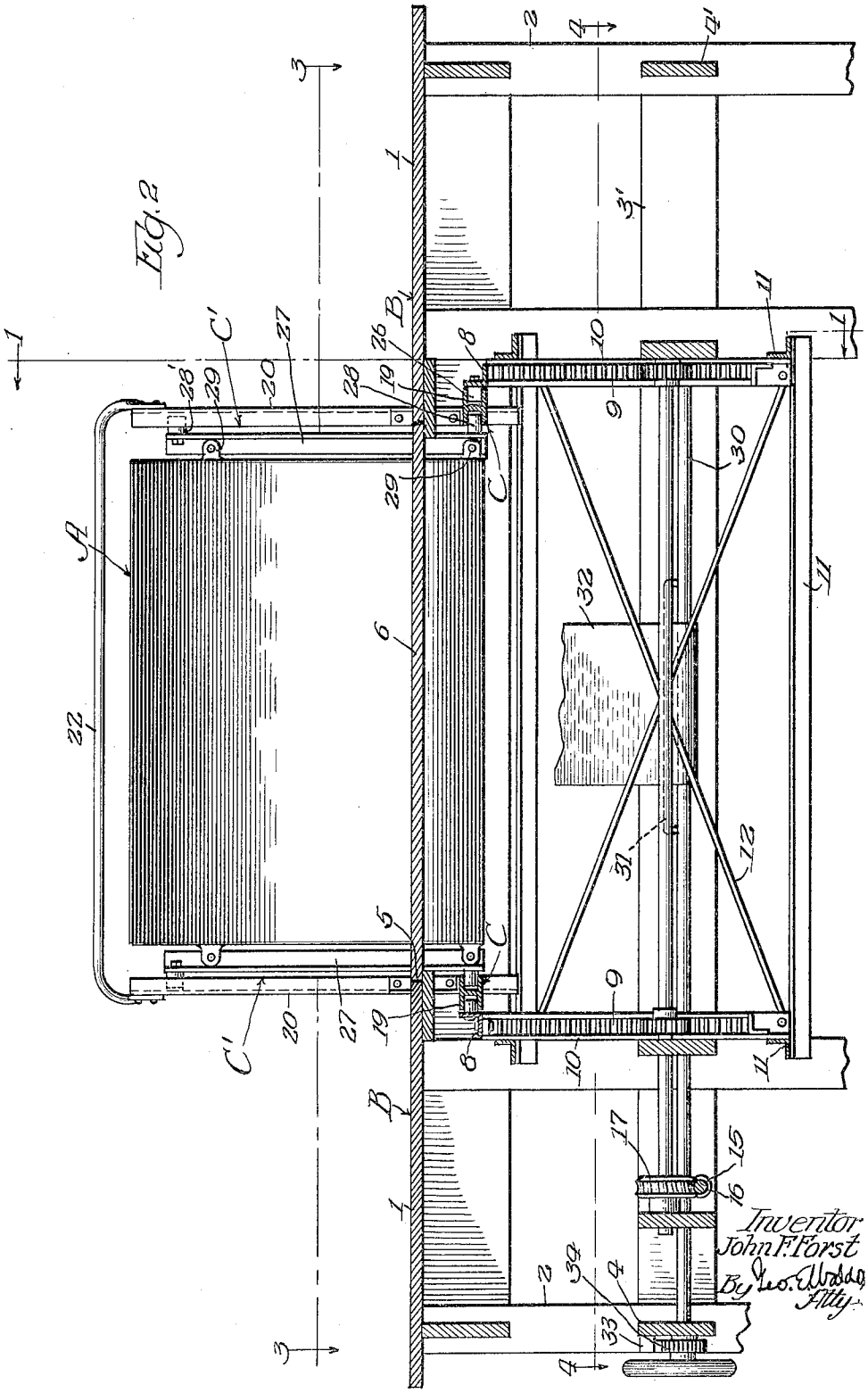
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X-RAY APPARATUS

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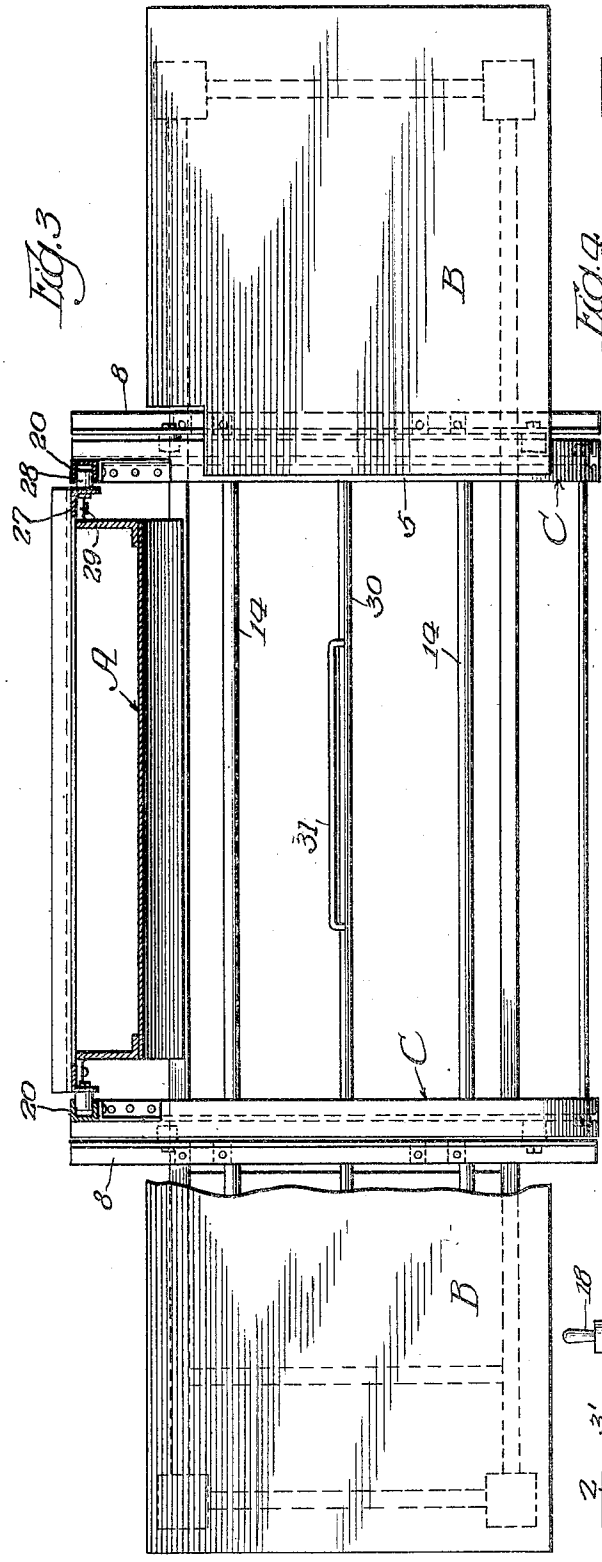
Fig. 2

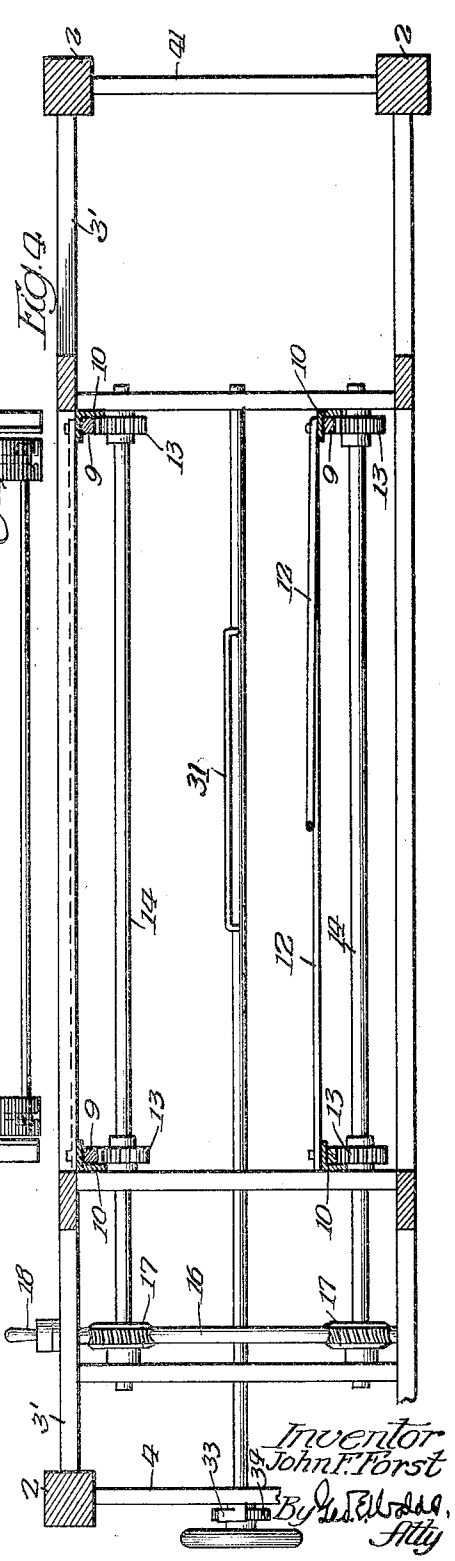


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X-RAY APPARATUS

Filed Aug. 29, 1932 3 Sheets-Sheet 3





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UNITED STATES PATENT OFFICE

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X-RAY APPARATUS

Application filed August 29, 1932. Serial No. 630,823.

This invention relates to X-ray apparatus and relates particularly to certain purely mechanical improvements in apparatus for mounting the grid or screen—specifically the screen known commercially as a "Bucky" diaphragm—in association with the table on which the patient rests and also in relation to the X-ray tube.

Stated broadly, the object of the invention is to provide means for making X-ray exposures of a patient from different positions—as from front and side—without changing the position of the patient and thus, without subjecting the patient to inconvenience, pain and suffering frequently incident to movement—particularly in accident cases.

Considered specifically, the object of the invention is the provision of means for adjustably mounting a screen—specifically a "Bucky" diaphragm—so that it may be moved into different positions to provide for taking X-ray photographs of a patient from corresponding positions without moving the patient.

A further object of the invention is to provide means for strapping the patient in position on the table by simultaneously winding both ends of the strap or web upon a reel, thus avoiding all tendency to turn or roll the patient from an initial position.

To effect these and other objects of the invention, an X-ray apparatus embodying my invention and improvements comprises the various features, combinations of features and details of construction hereinafter described and claimed.

In the accompanying drawings, in which the invention is fully illustrated,

Fig. 1 is a sectional end elevation, substantially on the line 1—1 of Fig. 2, of an X-ray table equipped with adjustable diaphragm supporting means of my invention, showing the diaphragm and X-ray tube in different positions, one in full lines and one in dotted lines, with the position of the patient, indicated diagrammatically, unchanged.

Fig. 2 is a sectional side elevation substantially on the line 2—2 of Fig. 1, the diaphragm being shown in its rearward position only and the patient not being indicated.

Fig. 3 is a sectional top plan view substantially on the line 3—3 of Fig. 2, showing the opening in the table top adapted to receive the diaphragm when making exposures from above.

Fig. 4 is a sectional top plan view substantially on the line 4—4 of Fig. 2; and

Figs. 5, 6, 7 and 8 are enlarged, fragmentary, perspective, detail views.

Describing the invention with reference to the drawings, in which, for purposes of clear and definite illustration, I have shown my invention and improvements as applied in use for mounting what we will assume is a "Bucky" diaphragm, designated as a whole A, on an operating table designated as a whole B.

"Bucky" diaphragms may be purchased commercially and are generally well known to X-ray operators and will be readily understood without a description thereof in detail.

Excepting as hereinafter may be particularly described and pointed out, the table B is a conventional structure, comprising a top 1, supporting legs 2 which are rigidly connected at their upper ends and intermediate their ends by longitudinal and transverse frame members, designated, respectively, 3, 3′, and 4, 4′, in a usual manner.

For reasons presently apparent, an opening 5 is formed in the table top 1 which is adapted to be closed, when desired, by removable boards or slats 6, as shown in Fig. 2.

In describing the construction and operation of my improved apparatus, I have shown, at 7, Fig. 1, what we will assume is the body of a patient lying prone on the table B in position to be X-rayed.

To attain the object of the invention, as it relates to taking X-rays of a patient 7 from different positions without moving the patient, the "Bucky" diaphragm A is adjustably supported so that it may be moved from a position below the patient, indicated in dotted lines, Fig. 1, to an edgewise posi-

tion at one side of the patient substantially 90° from its initial position, said second position being shown in full lines, and vice versa, by means as follows:

Mounted on the table B is a frame comprising a lower section designated as a whole C, which is vertically adjustable in the manner presently described, and an upper section C′ mounted on said lower frame section so as to be vertically adjustable therewith and so, also, as to be horizontally adjustable thereon.

As shown, the lower frame section C consists of upper transverse frame members 8, rigidly secured to each of which is spaced relation transversely of the table B, is a pair of upright rack bars 9, which are slidably fitted to vertical guides consisting, as shown, see particularly Figs. 1 and 2, of angle bars 10 secured in upright parallel positions to rigid parts of the table B, as shown, the lower ends of said pairs of angle bars being rigidly connected by transverse braces 11 consisting, as shown, of angle bars, and the upper and lower ends of angle bars 10 of different pairs thereof on the same side of the table, being connected by diagonal braces 12.

Said lower frame section C is adapted to be adjusted vertically by pinions 13 secured to shafts 14 rotatably mounted in bearings at opposite sides of the table B, and which mesh with corresponding rack bars 9, see particularly Figs. 1 and 4. Also, rotation is adapted to be imparted to the shafts 14 to raise and lower said lower frame section by worm gears comprising worms 15 secured to a worm shaft 16 rotatably mounted in bearings in fixed parts of the table B, as shown, and worm wheels 17 secured to the shafts 14 with which the worms 15 intermesh. Rotation is adapted to be imparted to the worm shaft 16 to raise and lower said lower frame section C, by means of a crank 18 secured thereto. Said worms are self-locking and will maintain said lower frame section in adjusted position without other securing means, in a familiar manner.

As shown, the upper frame section C′ comprises substantially similar right and left hand frames, each comprising horizontal and vertical members 19 and 20, the members 20 being rigidly connected adjacent their lower ends to the rear ends of the horizontal members 19 by suitable means, as shown, by gusset plates 21. Said side frames are rigidly connected by a cross-bar or rod 22, opposite ends of which are riveted or otherwise secured to the upper ends of the vertical frame members 20.

The horizontal frame members 19 are provided with longitudinal grooves or channels in both lateral sides thereof, comprising outwardly facing grooves 23 and inwardly facing grooves 24, while the vertical frame members 20 are provided with channels 25 in their inner sides only, the grooves or channels 24 and 25 being continuous with each other, that is, forming horizontal and vertical extensions of each other, respectively.

As the apparatus is assembled for operation, spaced roller studs 26 on the frame members 8 of the lower frame section 6 engage the outwardly facing grooves or channels 23 in the horizontal frame members 19 of the upper frame section C′, thus providing for moving the upper frame section C′ laterally relative to said lower frame section C.

Also, the diaphragm A is mounted in the upper frame section C′ by means of bars 27 secured to opposite ends of said diaphragm, mounted on which are spaced roller studs 28, 28′, arranged to engage the inwardly facing grooves or channels 24 and 25 formed in the frame members 19 and 20 of said upper frame section. As shown, the bars 27 are made of angle iron, each thereof being disposed with one flange parallel with the plane of the base of the diaphragm A and the other flange extending at right angles thereto, the flanges which are parallel with the plane of the base of the diaphragm being secured to lugs 29 on the diaphragm and the roller studs 28, 28′ being secured to the other flanges of said angle bars, said roller studs preferably being arranged with their remote sides tangent to the opposite sides of the diaghragm, produced or extended.

With the diaphragm A mounted in the manner described, it will be movably supported and will be stable in its operating positions, to-wit, see Fig. 1, its horizontal position, shown in dotted lines, and in its vertical or edgewise position, shown in full lines, and may quickly and conveniently be shifted from one position to the other.

Thus, to shift the diaphragm from horizontal to vertical position, it is only necessary to move it along the guide grooves 24 to bring the rear roller studs 28′ mounted thereon in line with the grooves or channels 25 in the upright frame members 20, and to then raise the rear side of the diaphragm until the front roller studs 28 are also in line with said grooves or channels 25. In this position, the weight of the diaphragm will tend to cause the top thereof to fall or tip inwardly upon the table and will thus hold it stable in its vertical position. To move said diaphragm from vertical to horizontal position, it is only necessary to exert a push or pull on the lower side of the diaphragm in the proper direction, at the same time supporting its rear edge to prevent shock when the rear roller studs 28′ contact with the lower side of the grooves or channels 24.

To attain the object of the invention as it relates to strapping the patient in position without exerting a pull tending to roll the patient over in one direction or the other, which, in many cases, would subject the patient to discomfort and possible pain, I attain the object of the invention by the use of a reel consisting of a shaft or rod 30 rotatably mounted in bearings in the machine frame, formed on which is a loop 31. The strap 32 having been adjusted across the body of the patient and the ends thereof, which, as previously stated, have been thickened as by a hem, are inserted through the loops 31 so that when the shaft 30 is turned both ends of the strap will be wound upon the common reel and thus shortened substantially uniform, which will operate in an obvious manner to bind the patient in position but without exerting any turning pull. When the strap 32 has been shortened sufficiently to subject the patient to desired restraint, the shaft 30 will be locked in position, simple means for this purpose consisting, as shown, of a pawl 33 pivoted to a rigid part of the table, which is adapted to engage the teeth of a ratchet wheel 34 secured to said shaft, in a usual manner.

Having thus described the construction of my improved apparatus, I will now describe the manner of using it to effect the object of the invention as it relates to taking X-rays of a patient from different positions without changing the position of the patient, particular reference being had to Fig. 1 of the drawings.

In the following description, we will assume that an X-ray has been taken of the patient lying prone on the table B—indicated diagrammatically at 7—by means of an X-ray tube positioned above the patient, indicated at 35, during which the diaphragm A is supported in horizontal position below the patient, as shown in dotted lines, the slats 6 having been removed and the diaphragm adjusted vertically through the opening 5 in the top of the table to bring it into desired relation to the body of the patient.

It now being desired to take an X-ray of the patient from the side, this can be effected by means of my improved apparatus without turning the patient by means of an X-ray tube mounted at the front side of the table, indicated at 36, in the following manner: The diaphragm supporting frame is lowered bodily to a position sufficiently below the patient to permit the diaphragm to be turned from horizontal to vertical position without coming in contact with the patient, which can be readily effected by turning the worm shaft 16 in the proper direction. Preferably, also, when the diaphragm is thus lowered, some or all of the slats 6 will be replaced to close the opening 5 and thus provide a support for the body of the patient. When the diaphragm supporting frame has been lowered to a position where it will clear the body 7 of the patient, its position in the supporting frame C, C′, may be changed from that shown in dotted lines, that is from a position below the patient, to that shown in full lines—that is to a position at the side of the patient remote from the X-ray tube 36—by first moving the diaphragm to bring the rear roller studs 28′ thereof in line with the grooves or channels 25 in the upright frame members 20 and in then raising the rear side of said diaphragm, causing the rear roller studs 28′ to move upwardly in the guide grooves 25. As previously stated, the body of the diaphragm will overhang its points of support and will thus be maintained in stable position by gravity.

In like manner, when it is desired to move the diaphragm from its vertical to its horizontal position with a patient lying on the table, the worm shaft 16 is first manipulated to lower the frame C, C′, so that the diaphragm will clear the body of the patient. By exerting a frontward pull or push on the lower end of the diaphragm, the roller studs 28 will be caused to run frontwards in the inwardly facing grooves 24 until the rear roller studs 28′ contact with the bottom of said channels 25. In thus adjusting a diaphragm from vertical to horizontal position, the rear sides thereof preferably will be supported so that the diaphragm will not be subjected to a jolt or jar when the roller studs 28′ contact with the bottom of the grooves 24.

I claim:

1. In apparatus for the purpose specified, the combination of a grid, a supporting structure, means for adjustably mounting said grid on said supporting structure, comprising a frame consisting of lower and upper sections, vertical guides for adjustably mounting the lower frame section on said supporting structure, and horizontal guides for adjustably mounting the upper frame section on the lower frame section, said upper frame section comprising connected right and left hand members, and means for adjustably mounting the grid directly on said upper frame section consisting of connected horizontal and vertical guides on the members of said upper frame section, and spaced projections on opposite ends of the grid which engage said guides, the relation providing for movement of the grid from horizontal to edgewise position and vice versa, relative to said supporting structure.

2. The apparatus specified in claim 1, which also comprises means for adjusting the grid supporting frame vertically.

3. The apparatus specified in claim 1, which also comprises means for adjusting the grid supporting frame vertically and for securing it in adjusted position.

4. The apparatus specified in claim 1, which also comprises self-locking means for adjusting the grid supporting frame vertically, comprising vertical rack bars on the lower section of said grid supporting frame, shafts rotatably mounted in bearings in the supporting structure, gears secured thereto which intermesh with the racks on the rack bars on the lower frame section, and a worm gear for simultaneously rotating said shafts.

5. The apparatus specified in claim 1, in which the supporting structure is provided with an opening in its top positioned to permit contemplated adjustments of the grid, and comprises removable means for closing said opening.

6. The apparatus specified in claim 1, in which the lower section of the grid supporting frame consists of transverse horizontal end bars, and vertical rack bars secured thereto, and the guides for mounting the lower frame section consist of vertical angle bars secured in fixed position on the supporting structure, into the angles of which the rack bars on said lower frame section are slidably fitted.

7. The apparatus specified in claim 1, in which the lower section of the grid supporting frame includes transverse, horizontal end bars and the means for mounting the upper section of the grid frame comprises projections on said end bars which engage guide channels formed in the outer sides of the horizontal bars of the upper section of said grid supporting frame.

8. The apparatus specified in claim 1, in which the means for adjustably mounting the grid in the upper section of the grid supporting frame, consists of spaced studs on opposite ends of the grid which engage guide grooves formed in the inner sides of the horizontal and vertical side frame members of the upper section of the grid supporting frame.

9. The apparatus specified in claim 1, in which the means for adjustably mounting the grid in the upper section of the grid supporting frame, consists of spaced studs mounted on bars secured to opposite ends of the grid which engage guide grooves formed in the inner sides of the horizontal and vertical side frame members of the upper section of the grid supporting frame.

10. The apparatus specified in claim 1, which also comprises means for strapping a patient in position on the supporting structure, comprising a strap adapted to be adjusted over the patient, a shaft rotatably mounted in the supporting structure, means for engaging both ends of the strap with said shaft, means for rotating said shaft to thereby reel both ends of the strap upon said shaft, and means for locking said shaft against rotation in a direction to unreel said strap.

11. In apparatus for the purpose specified, the combination of a grid, a supporting structure, means for adjustably supporting said grid on said supporting structure comprising a lower frame section, engaging vertical guides on said supporting structure and lower frame section for guiding said lower frame section vertically, means for raising and lowering said frame section and for securing it in adjusted positions, an upper frame section on which the grid is mounted directly, consisting of spaced right and left hand members comprising horizontal bars provided with inwardly and outwardly facing guide channels, and vertical bars rigidly secured adjacent their lower ends to said horizontal bars adjacent their rear ends, provided with inwardly facing guide channels which are continuous with the inwardly facing guide channels in the horizontal bars of said upper frame section, means connecting opposite side members of said upper frame section, spaced studs on the lower frame section which engage the outwardly facing guide channels in the horizontal bars forming parts of the upper frame section, and spaced studs on opposite ends of the grid comprising pairs of studs respectively arranged to engage the inwardly facing guide channels in the horizontal and vertical bars, respectively, of the upper frame section, the relation providing for movement of the grid from horizontal to vertical position and vice versa and rendering said grid stable in both positions.

In witness that I claim the foregoing as my invention, I affix my signature this 16th day of August, 1932.

JOHN F. FORST.