

April 5, 1927.

C. E. CAMPBELL

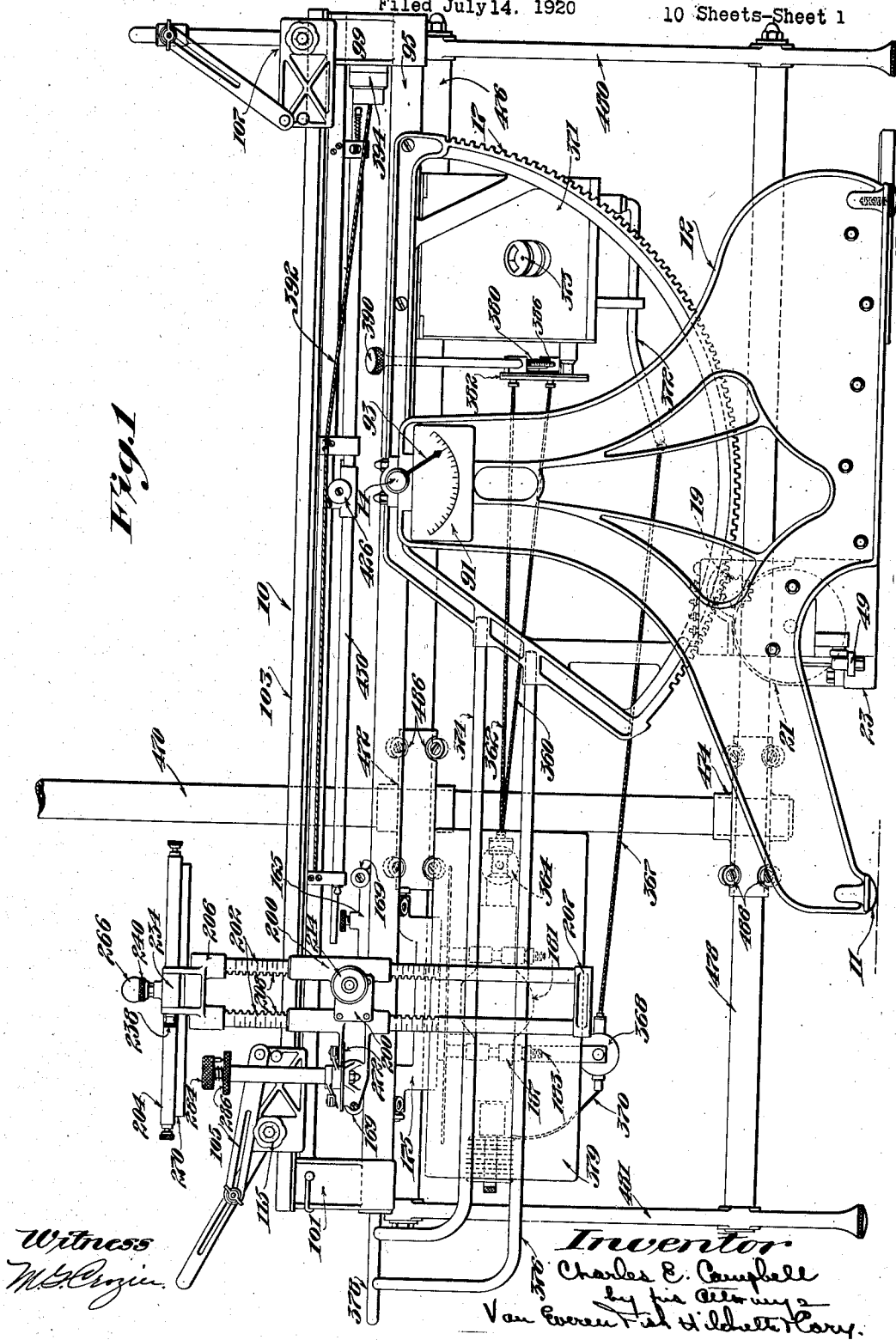
1,623,575

X-RAY APPARATUS

Filed July 14, 1920

10 Sheets-Sheet 1

Fig. 1



Witness
M. E. Ogden

Inventor
Charles E. Campbell
by his Attorneys
Van Buren, Felt & Aldrich, Corp.

April 5, 1927.

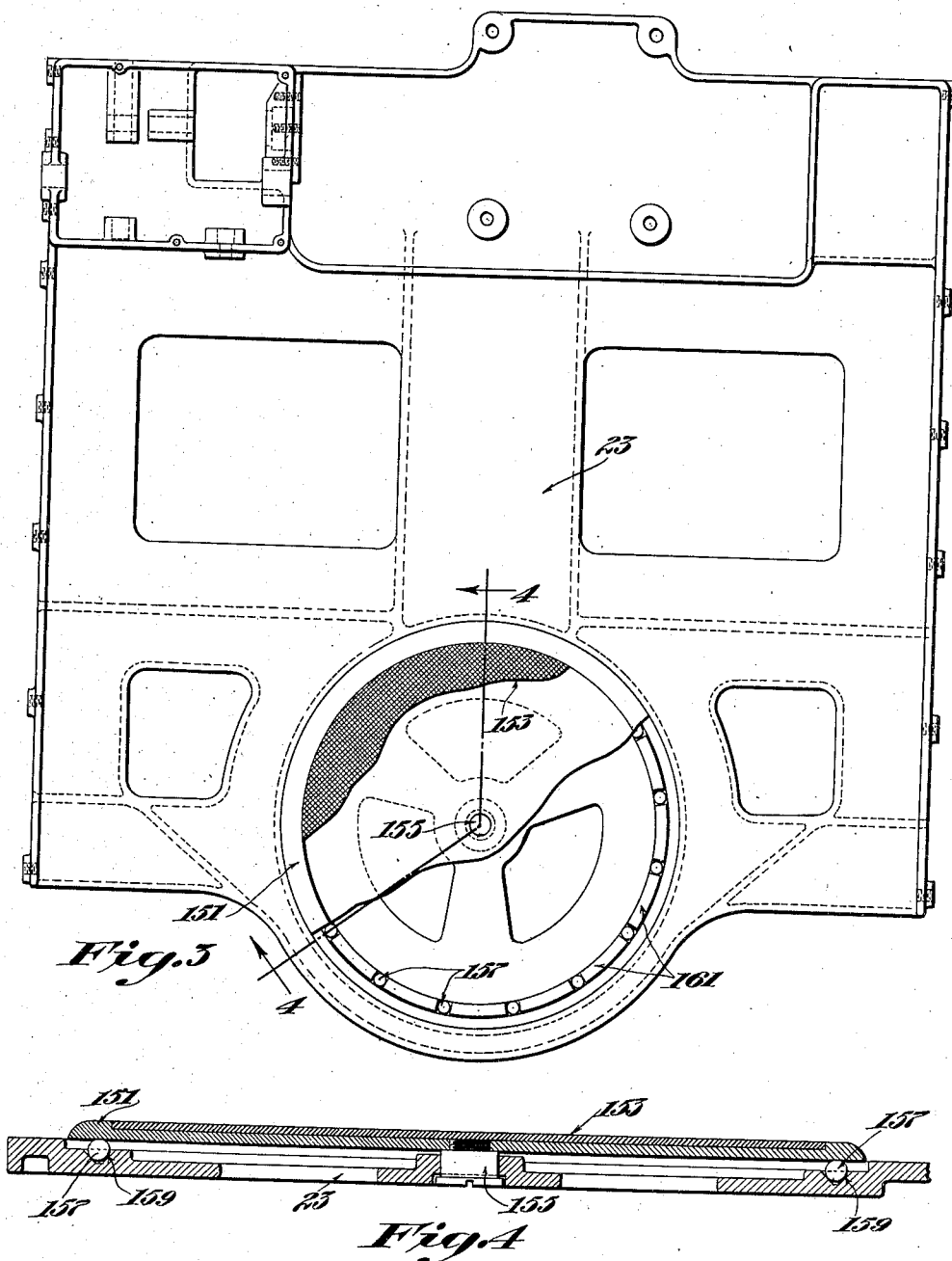
C. E. CAMPBELL

1,623,575

X-RAY APPARATUS

Filed July 14, 1920

10 Sheets-Sheet 3



Witness
M. C. Quinn

Inventor
Charles E. Campbell
by his attorneys
Van Eenun Fishelbein & Cary

April 5, 1927.

C. E. CAMPBELL

1,623,575

X-RAY APPARATUS

Filed July 14, 1920

10 Sheets-Sheet 4

Fig. 5

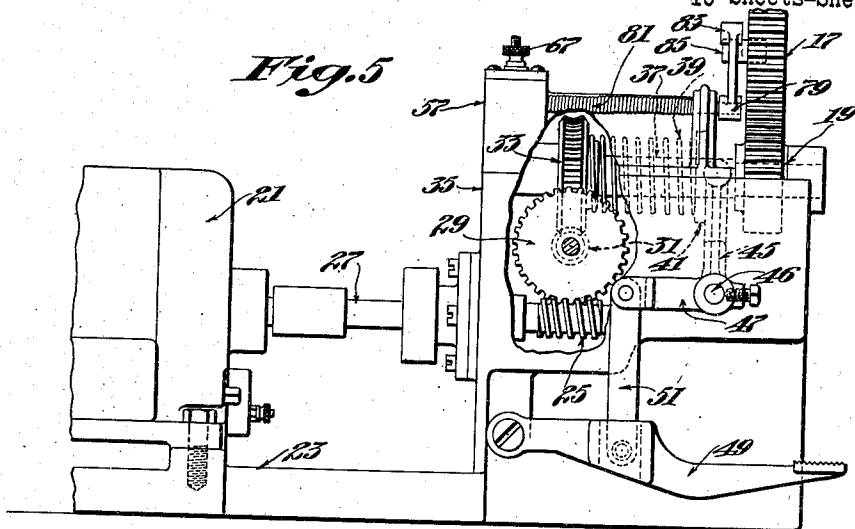


Fig. 6

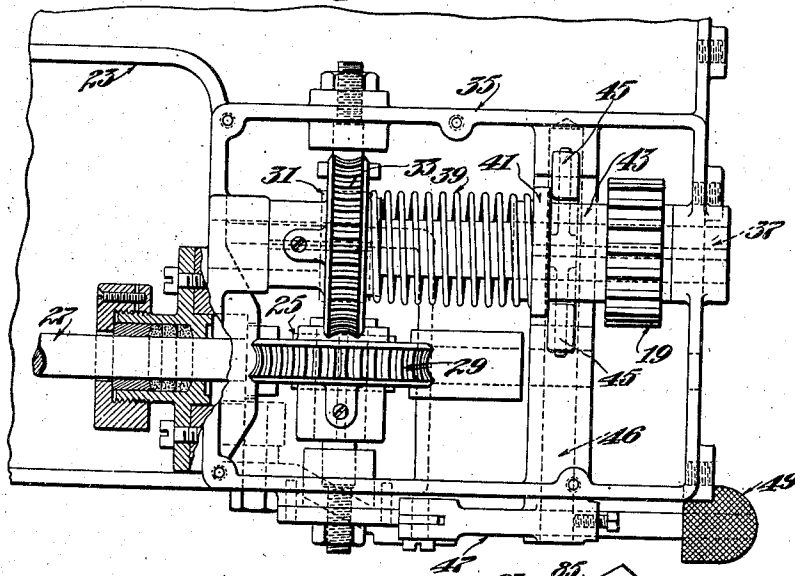
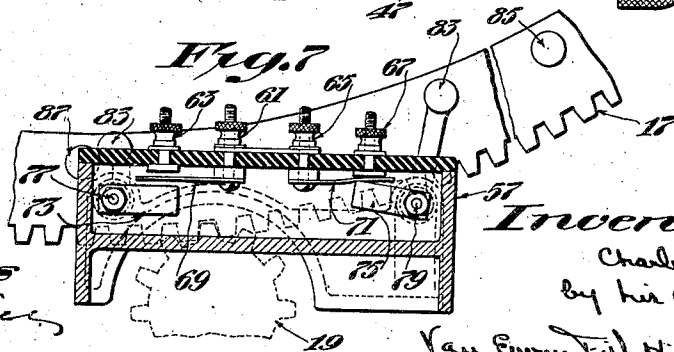


Fig. 7



Witness
M. Crozier

Inventor

Charles E. Campbell
by his Attorney

Van Eenre Fisk Hildreth, Esq.

April 5, 1927.

C. E. CAMPBELL

1,623,575

X-RAY APPARATUS

Filed July 14, 1920

10 Sheets-Sheet 5

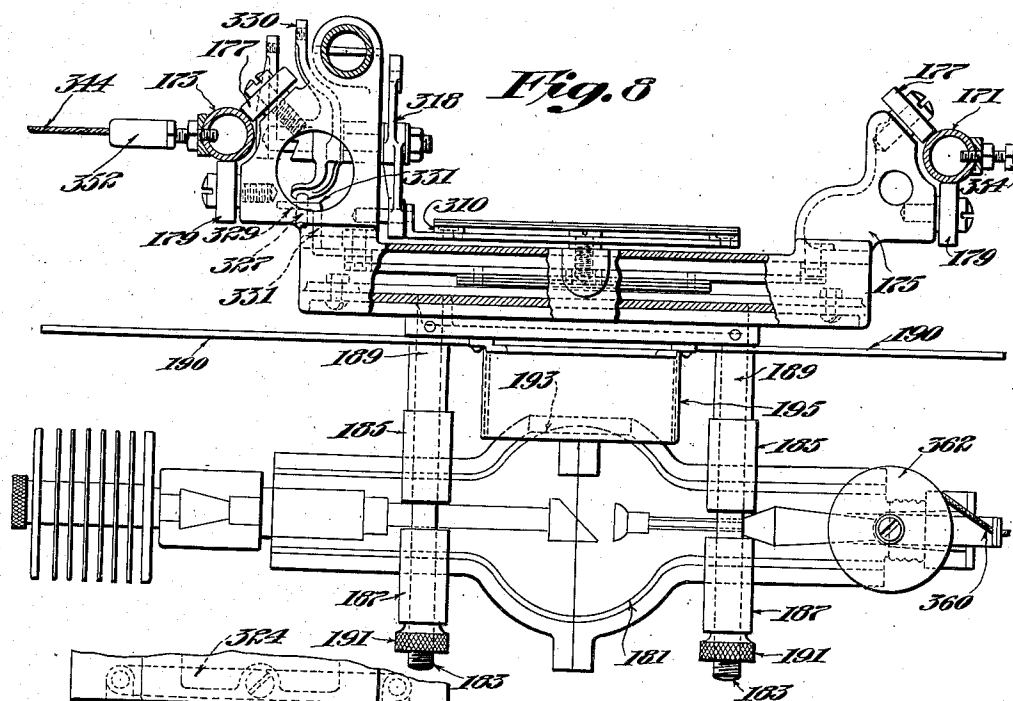


Fig. 8

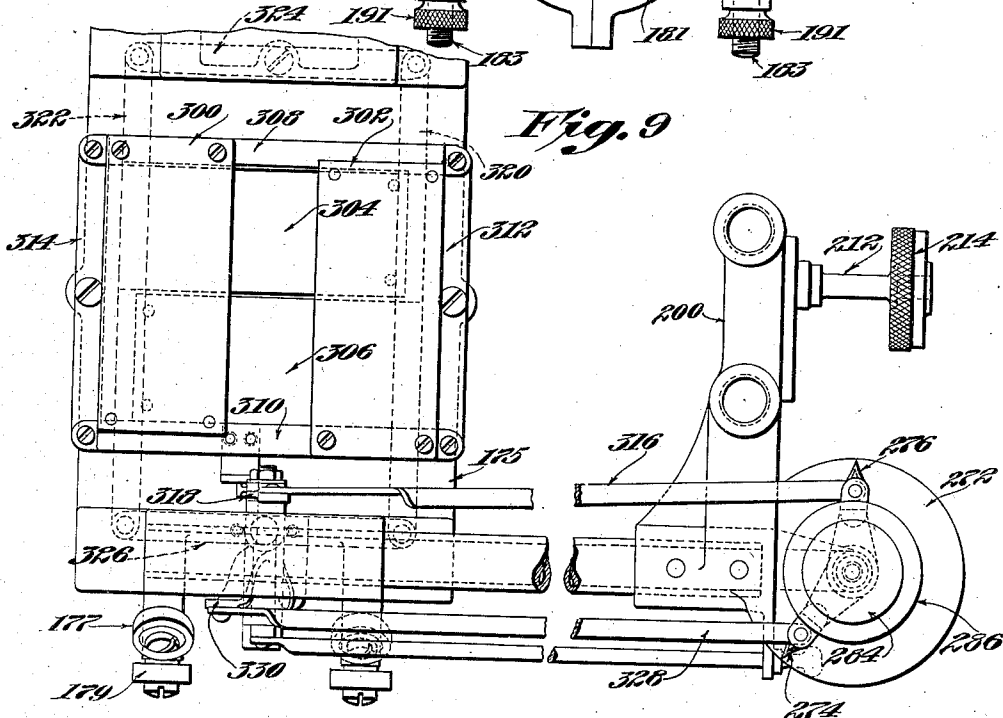


Fig. 9

Witness
M. B. Quinn

Inventor
Charles E. Campbell
by his Attorneys
Van Eiman Fish & Gilbert Cary

April 5, 1927.

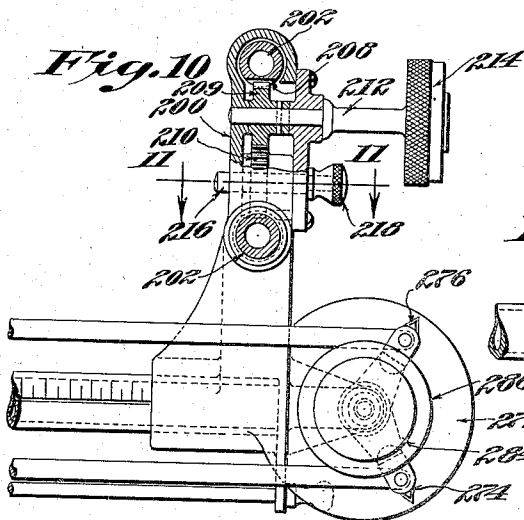
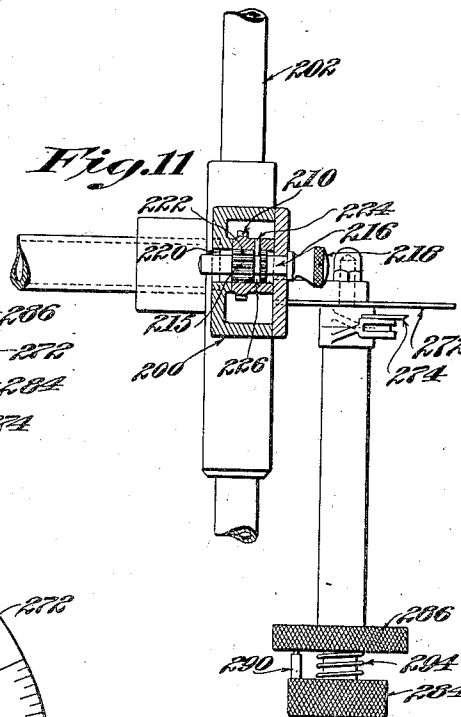
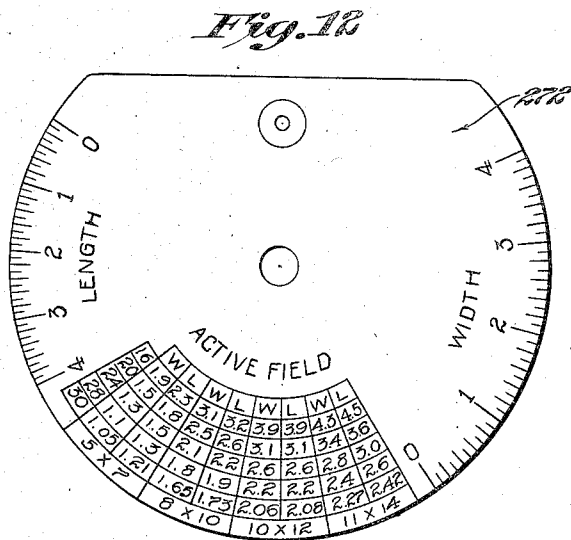
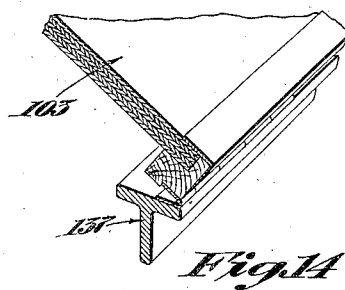
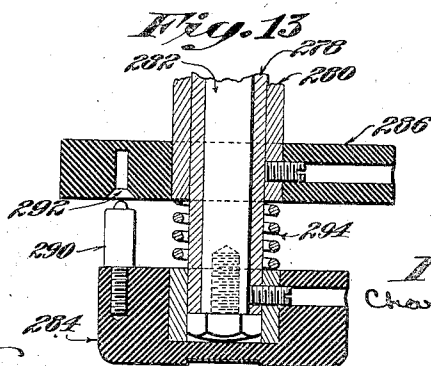
C. E. CAMPBELL

1,623,575

X-RAY APPARATUS

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10 Sheets-Sheet 6



Witness
M. J. Crozier

Inventor
Charles E. Campbell
by his Attorneys

Van Everen Fish & Willard, New York

April 5, 1927.

1,623,575

C. E. CAMPBELL

X-RAY APPARATUS

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10 Sheets-Sheet 7

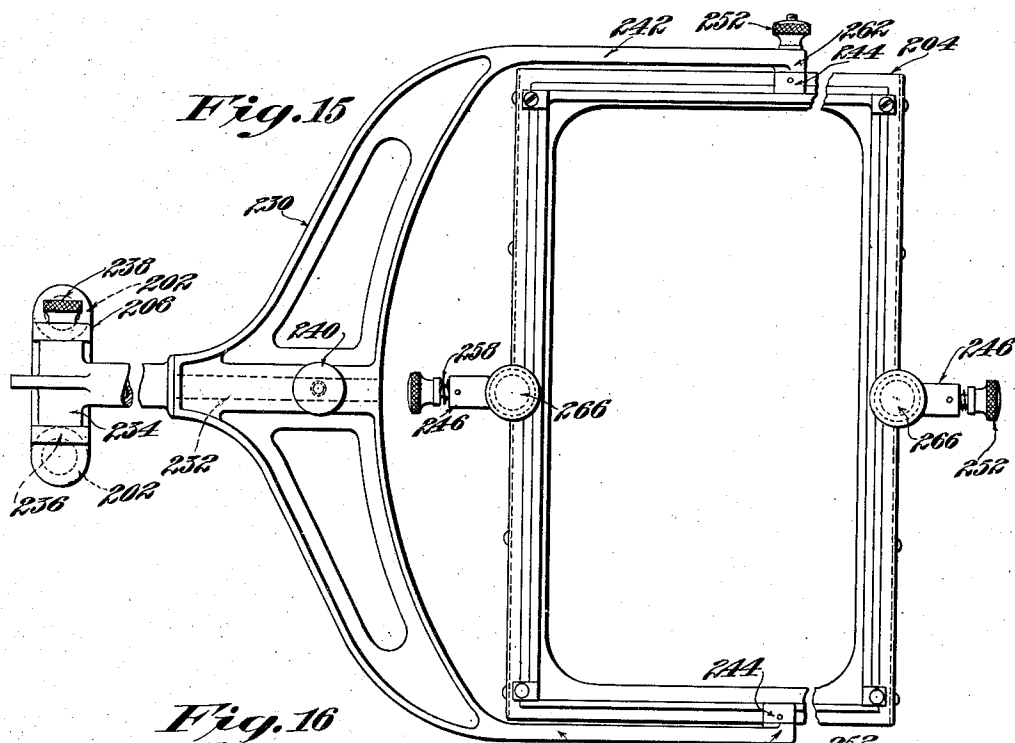
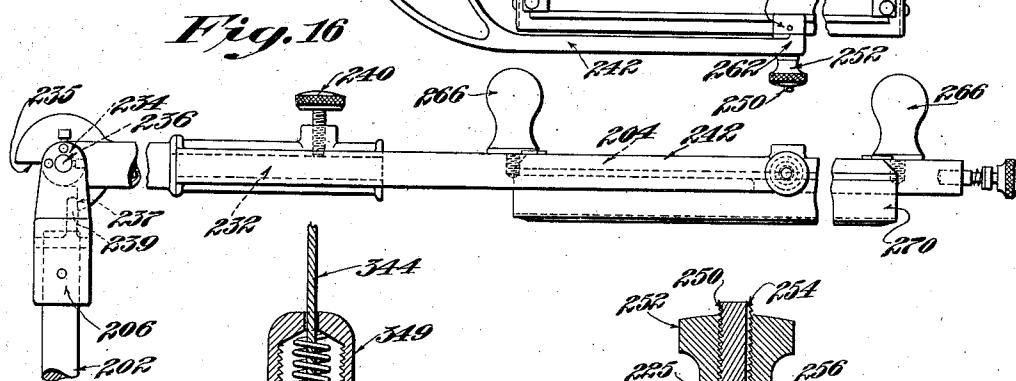
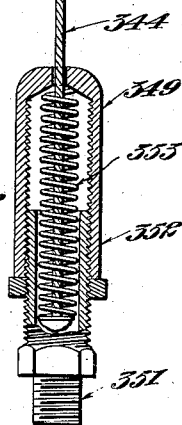
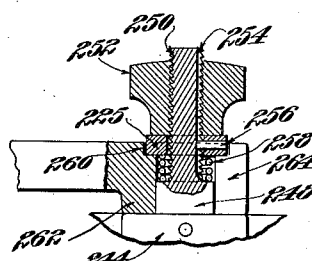


Fig. 16



Witness
M. G. Ogden

Inventor
Charles E. Campbell
by his Attorney
Van Euren Fish & Hubbard & Co.

April 5, 1927.

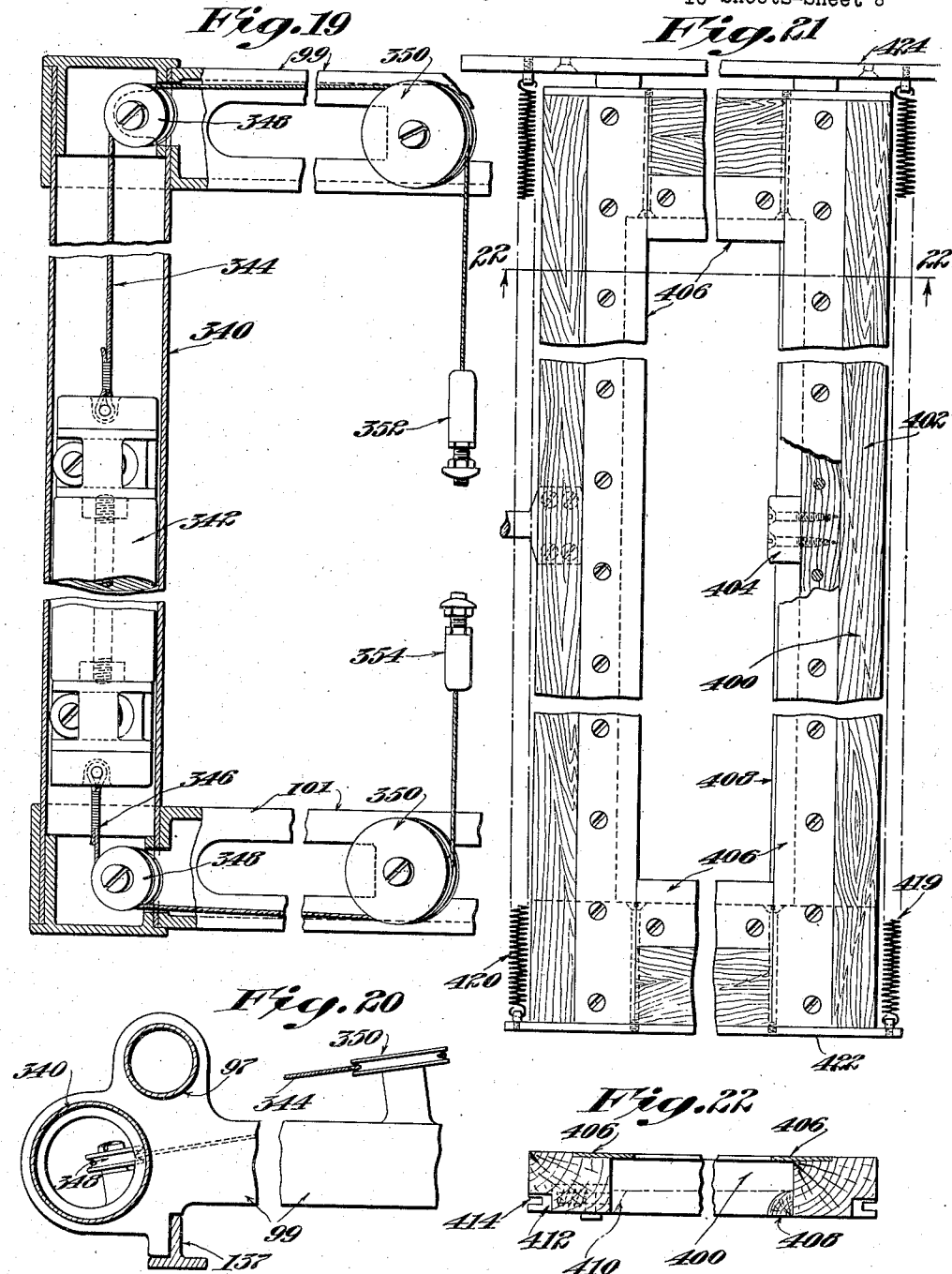
C. E. CAMPBELL

1,623,575

X-RAY APPARATUS

Filed July 14, 1920

10 Sheets-Sheet 8



Witness

Inventor

Charles E. Campbell
by his Attorneys
Van Euren Fish & Hilbert Lewis

April 5, 1927.

1,623,575

C. E. CAMPBELL

X-RAY APPARATUS

Filed July 14, 1920

10 Sheets-Sheet 9

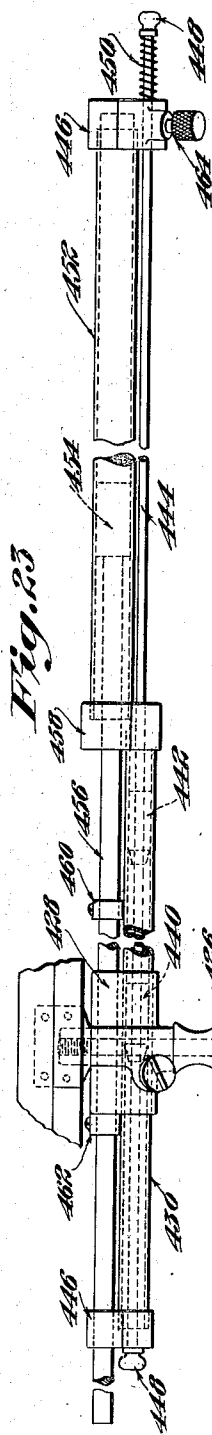


Fig. 23

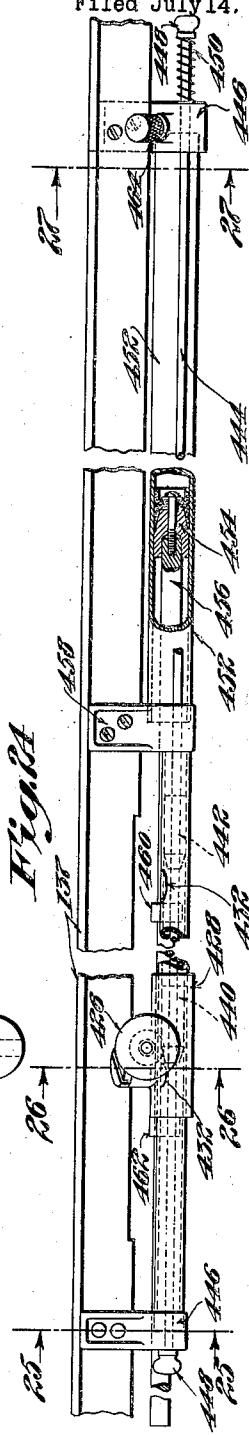


Fig. 24

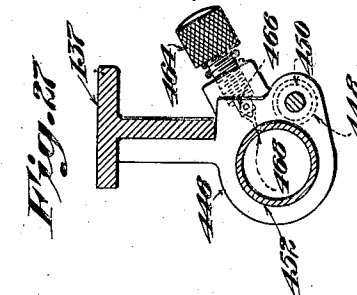


Fig. 27

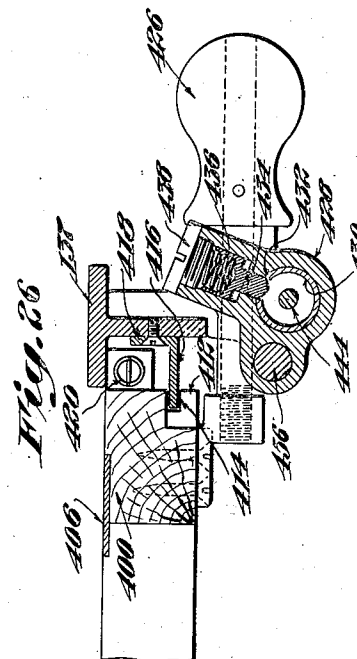


Fig. 26

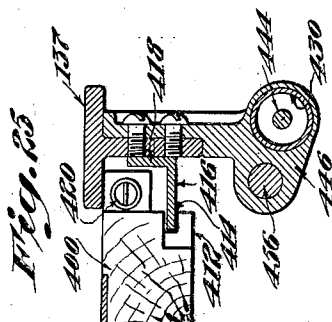


Fig. 25

Witness
M. J. O'Brien

Inventor
Charles E. Campbell
by his attorney
Vose Everett Fish & Leach & Co.

April 5, 1927.

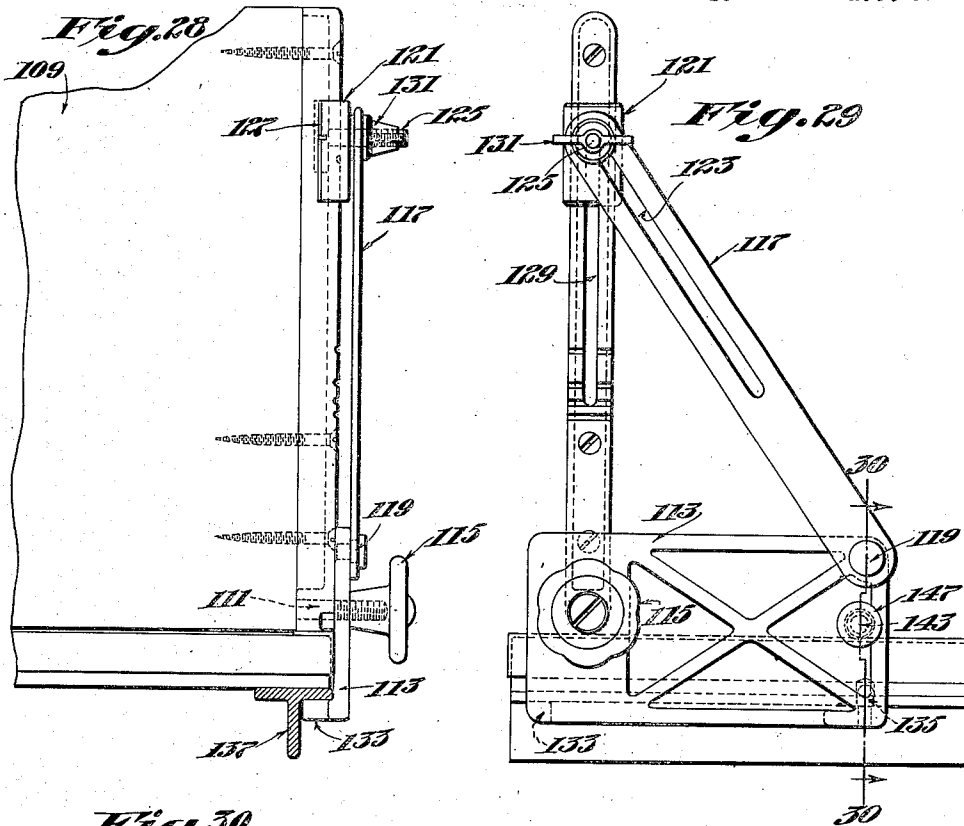
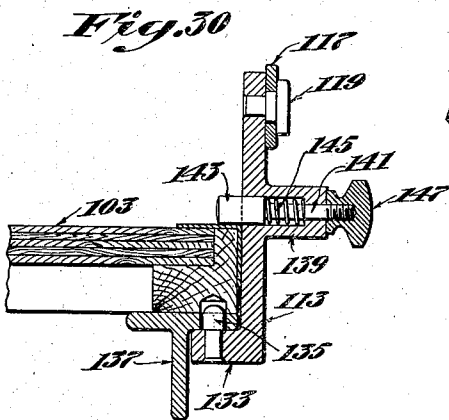
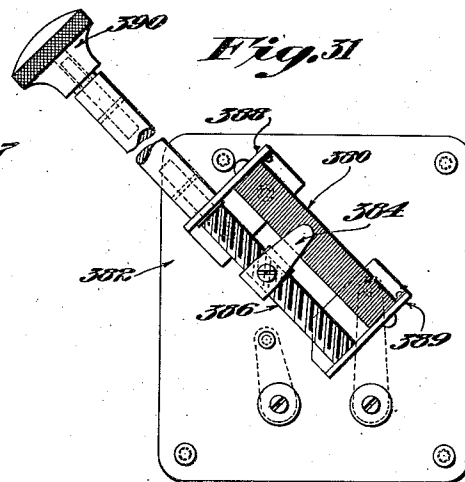
C. E. CAMPBELL

1,623,575

X-RAY APPARATUS

Filed July 14, 1920

10 Sheets-Sheet 10



Witness
M. E. Crozier

Inventor
Charles E. Campbell
by his attorneys
Van Eunen Fish & Hilbert Cary.

UNITED STATES PATENT OFFICE.

CHARLES E. CAMPBELL, OF LYNN, MASSACHUSETTS, ASSIGNOR TO CAMPBELL ELECTRIC COMPANY, OF LYNN, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

X-RAY APPARATUS.

Application filed July 14, 1920. Serial No. 396,098.

The present invention relates to X-ray apparatus, and more particularly to X-ray tables employed for making X-ray examinations and radiographs.

5 The object of the present invention is to provide a new and improved form of X-ray table which facilitates the examination and radiographing of any desired portion of the human anatomy.

10 With this object in view the several characteristics of the invention consist in certain novel features of construction and combinations and arrangements of parts hereinafter described and claimed, the advantages of which will be obvious to those skilled in the art from the following description.

15 In the accompanying drawings illustrating the preferred form of the invention, Figure 1 represents a side elevation of an X-ray table embodying the several features of the invention; Figure 2 is an end view of the X-ray table with the bed portion located in a substantially vertical position to show the mechanism beneath the bed; Figure 3 is a detail illustrating a plan view of the supporting base separated from the table; Figure 4 is a detail showing a section upon the line 4—4 of Figure 3; Figure 5 is a detail showing an elevation partly in section of the motor driving mechanism for tilting the table; Figure 6 is a plan view of the motor driving mechanism shown in Figure 5 with the cap removed from the enclosing casing; Figure 7 is a detail illustrating a section of the motor switch box showing the switches for automatically limiting the tilting movement of the table in opposite directions; Figure 8 is a detail illustrating an elevation partly in section of the tube carriage; Figure 9 is a detail illustrating the mechanism for controlling the movement of the shutters; Figure 10 is another view of the controlling mechanism for the shutters shown in Figure 9; Figure 11 is a section upon the line 11—11, Figure 10; Figure 12 is a detail showing a plan view of the dial for indicating the proper shutter opening at any given height of the plate holding device above the table; Figure 13 is a detail showing a cross-section of the handles for controlling the movements of the two shutters; Figure 14 is a detail illustrating the connection by which the table top is hinged to the frame; Figure 15 is a plan view of the mechanism for holding the fluorescent screen in place; Figure 16

is a side elevation of the mechanism shown in Figure 15; Figure 17 is a detail of the detachable connection for fastening the screen frame to the holder; Figure 18 is a detail illustrating a sectional elevation of the yielding connection between the counter-weight and the tube carriage; Figure 19 is a sectional plan of the tube carriage counter-weight and connecting mechanism; Figure 20 is a detail illustrating an end view of the counter-weight connection shown in Figure 19; Figure 21 is a plan view of the plate holder changing device supported beneath the table; Figure 22 is a cross-section of the device shown in Figure 21, taken upon the line 22—22; Figure 23 is a detail illustrating a plan view of the mechanism for controlling the shifting movement of the under plate holder; Figure 24 is a detail showing a side elevation partly in section of the mechanism shown in Figure 23; Figure 25 is a cross-section upon the line 25—25 of Figure 24; Figure 26 is a cross-section upon the line 26—26 of Figure 24; Figure 27 is a cross-section upon the line 27—27 of Figure 24; Figure 28 is a detail illustrating a front elevation of the foot rest; Figure 29 is a view of the rest shown in Figure 28 taken at right angles thereto; Figure 30 is a section of the rest and mechanism for locking it upon the table, taken upon the line 30—30 of Figure 29; Figure 31 is a detail illustrating a view of the adjustable resistance employed for controlling the flow of current through the filament.

The illustrated embodiment of the invention comprises a table indicated generally at 10, which is supported for tilting movement between two side standards 12 and 13. Each of the side standards is provided with two adjustable feet 11 by which the table may be leveled with respect to the floor. The table, as will be observed from an inspection of Figure 2, is provided with oppositely extending pivot shafts 14 and 15 which are received in bearings formed in the tops of the standards. The table is preferably tilted as a whole through a gear segment 17 secured to the side of the table inside of the standard 12 and meshing with a driving pinion 19. The driving pinion is normally actuated to tilt the table through an electric motor, but the connections are so designed that the motor may be disconnected and the table tilted by hand, if so desired. To this end, 110

an electric driving motor 21 is mounted upon the main base plate 23, and is connected with the driving pinion 19 through a double reduction worm gearing consisting of a worm 25, mounted upon the motor shaft 27, a driven gear 29, a worm 31 mounted upon the gear shaft, and an intermeshing gear 33 secured to the shaft carrying the driving pinion 19. It will be observed that this gearing as a whole is enclosed in a casing 35, forming an integral part of the base plate 23. In order to conveniently disconnect the motor drive from the table 10, and to permit the movement of the table by hand, the driving pinion 19 is splined upon the shaft 37 and is normally retained in the position shown in Figures 5 and 6 by a spring 39, which bears against one side of an annular flange 41 formed as a part of the hub 43. The opposite side of the flange is engaged by the two arms of a shifting fork 45, which is fulcrumed upon a shaft 46 extending outside the gear casing. This shaft outside of the casing is provided with an operating arm 47, which is connected with a foot treadle 49 through a short connecting rod 51. It will thus be observed that although the movement of the table is normally controlled by the electric motor 21, a depression of the foot treadle 49 will disconnect the driving pinion 19 from the gear segment 17, and permit the table to be moved manually. The operation of the electric motor 21 may be conveniently controlled through a suitable form of foot switch, as indicated at 53 in Figure 2, connected with the motor through a flexible cable indicated at 55. It is desirable to provide means for automatically limiting the movement of the table in opposite directions in the event that the motor circuit is inadvertently left closed too long. To this end a switch box 57 is mounted above the gear casing and contains two sets of members which automatically open the motor circuit when the table has moved a predetermined distance in either direction. As will be observed from an inspection of Figure 7 of the drawings, the upper portion of the switch box is provided with terminals 61, 63, 65 and 67, which are adapted to be connected into the motor circuit. The terminals 61 and 65 are provided with spring contact members 69 and 71, which are normally adapted to engage stationary contacts formed upon the inner ends of the terminals 63 and 67 to close the circuit. This engagement of the two sets of contacts is secured through arms 73 and 75, which are supported upon the inner ends of shafts 77 and 79, normally constrained to keep both arms in the position shown at the right in Figure 7 by coil springs 81. The outer end of each of the shafts 77 and 79 adjacent the gear segment 17 is provided with an outstanding arm 83 supported respectively in the path of movement of studs 85 and 87, projecting from the side of the gear segment. It will be obvious to those skilled in the art from an inspection of the drawings that with this construction, when the table is tilted in opposite directions to an extreme position, one of the studs 85 or 87 will engage with the corresponding arm 83 to permit the contact members to separate and automatically break the motor circuit. In this connection it may be stated that the motor 21 is of the familiar repulsion type which is designed to rotate in opposite directions, depending upon the circuit arrangement. In order to suitably control the rotation of the motor, the foot switch 53 is formed in two parts so that an actuation of each part will control the rotation of the motor in one direction. In order that the operator may conveniently be informed as to the angle of inclination of the table, an indicating dial 91 is formed upon the standard 12 and cooperates with an indicator hand 93 secured to the shaft 14 outside of the bearing. It will be observed from an inspection of Figure 1 that when the table is in a horizontal position, the indicator hand is in approximately the position indicated with respect to the dial. In this position the indicator hand has a sufficient range of movement with respect to the dial to permit the right hand end of the table to be moved downwardly until the table assumes approximately a vertical position or to permit the left hand end of the table to be dropped a substantial amount to incline the table in the opposite direction. In other words, the table construction is such that it may be rocked in opposite directions, thus permitting the patient to be moved into the Trendelenberg position, so called, in which the head is lower than the remaining portion of the body. The table is provided with two longitudinal tubular supports 95 and 97 which support upon their opposite ends castings 99 and 101, which in turn support a flat bed 103 of wood or other suitable material, which may be hinged to the supports as indicated in Figure 14, to permit it to be swung out of the way if so desired. It is essential, to provide a rest for the head or feet, or both, of a patient upon the table, and to this end a new form of rest is employed in connection with the table, which may be readily adjusted at various angles, or may be entirely removed from the table, if so desired. The head and foot rests are indicated respectively in Figure 1 at 105 and 107. As the two rests have the same construction and mode of operation, only a single rest will be described. Each of the rests is provided with a flat support 109, which is pivoted at its lower or inner edge upon oppositely extending studs 111, which are received in side plates 113. The support

109 is clamped in any angular position with relation to the side plates through the medium of clamp members 115 which threadedly engage with the outer ends of the studs 111. The upper portion of the support 109 is connected at opposite sides to the front of each side plate by a diagonal strut 117, which is pivoted at 119 to the side plate 113, and is adjustably connected at its opposite end with a slide member 121, which embraces the edge of the support 109. The diagonal strut 117 is provided with an elongated opening 123 which receives the connecting bolt 125 and permits a relative adjustment of the support and struts. As shown in Figure 28, the connecting bolt 125 is provided at its inner end with an enlarged head 127, which slides within a T-shaped slot 129 formed in the edge of the support. The outer end of the bolt threadedly engages with a wing nut 131, which may be tightened to clamp the support 109, the slide 121 and the strut 117, rigidly together. It will be observed that with this construction, not only may the support 109 be adjusted to any inclination relative to the bed of the table, but in addition the support may be adjusted into a position in which it lies flat along the bed, thus substantially moving it out of the way. In addition to the adjustment of the angle of the support, the rest as a whole may be adjusted lengthwise of the table, or entirely removed, if so desired. In order to make this latter adjustment possible, the side plates 113 are provided with turned flanges 133, each flange having a stud 135 projecting upwardly therefrom into one of a series of recesses formed in the parallel channel irons 137 supporting the bed 103. In addition, the side plate is provided with a boss 139 which receives a pin 141 having its inner end 143 projecting over the top of the bed, as shown in Figure 30, to retain the side plates in the relative positions shown in Figures 28 and 30. The pin 141 is normally retained in an operative position by a spring 145, and is provided upon its outer end with a handle 147 by which the end 143 may be withdrawn from the position shown. This mechanism normally serves to retain the rest locked in longitudinal position with respect to the bed, but upon withdrawal of the pins 141, the front end of the rest may be dropped sufficiently to disengage the pins 135 from the corresponding recesses, and the rest either moved to a new position longitudinally of the table, or completely removed from the table altogether. In order to permit the desired range of the adjustment of the rests, it is obvious that the under side of the bed must be provided with a series of pin receiving recesses located the proper distance apart.

In accordance with the above described construction it will be evident that the rest may

be moved substantially through an arc of 180°, permitting it to be adjusted into any one of several positions in which it may be either parallel with the table top or inclined with relation thereto.

When the table is located in either a horizontal or an inclined position, the patient will rest thereon, but for certain purposes it may be desirable for the patient to stand erect during the examination or taking of radiographs. To this end the table may be tilted into a substantially vertical position exposing a turn table 151 having a foot rest 153 of soft rubber, or other material. The turn table is swivelled upon the base 23 at 155, and is supported for rotary movement by anti-friction bearings 157, which travel in an annular ball race 159 formed in the base, the individual bearing members being separated by suitable spacing members 161. The freely movable turn table is a great convenience, as it permits the patient to be turned completely around with a slight effort, permitting the X-rays to be directed toward the body at any desired angle.

The present apparatus is self-contained in the sense that the transformer for producing the requisite voltage used in the source of X-ray is embodied in the table in such a manner that the high tension leads connecting the transformer with the source of X-ray are completely removed from the operator. With this construction the only leads connecting the table with the source of supply are low tension leads carrying current at commercial voltage, which do not form a source of danger to the person operating the table. The advantages of such a construction will be obvious to those skilled in the art. To this end the present invention comprises a transformer or similar mechanism supported upon the under side of the table in a stationary position, and connected with the source of X-ray through suitably disposed flexible leads. The X-ray tube is supported upon a carriage beneath the table, and is adjustable both longitudinally and transversely of the table through the movements of the carriage. In addition to the tube, the carriage also carries a fluoroscopic screen above the table and between which and the table the patient is supported. This screen is located directly over the source of X-ray with its center aligned with the tube, and is adjustable in order that the best position with relation to the organ to be examined may be secured. The frame carrying the screen in addition contains a receptacle for radiographic plates directly beneath the screen, so that the image of the object to be radiographed may be first cast upon the screen, and then the radiograph taken with the assurance that it will be located identical with the image thrown upon the screen. Connected with

the carriage is a mechanism for operating the shutters, so designed that the proper shutter opening may be obtained for any desired size of picture in different given positions of the screen and plates above the surface of the table.

In the illustrated embodiment of the invention, a travelling carriage indicated at 165 is supported for longitudinal movement upon the tubular members 95 and 97. The carriage, as will be evident from an inspection of Figures 1 and 2, is freely movable along the members through the medium of cooperating anti-friction rolls 167 and 169, which are journaled at the four corners of the carriage and engage opposite sides of each standard, as indicated. In addition to its movement longitudinally of the table, the carriage has provision for movement transversely of the table, and to this end two transversely arranged tubular members 171 and 173 are provided, upon which moves the tube carrying frame 175. This frame is supported upon the tubular members 171 and 173 through the medium of anti-friction rolls 177 and 179, engaging with opposite sides respectively of the tubular members, as indicated clearly in Figure 8. The frame 175 carries upon its under side an X-ray tube 181. This tube is connected to the carriage through a plurality of depending posts 183 and cooperating clamps 185 and 187, which are supported upon the posts and insulated from the carriage by sleeves 189. As shown in Figure 2, lead plates 190 are held under sleeves 189. The tube is held rigidly between the clamping members by knurled nuts 191 threaded upon the lower end of the standards. The tube shield, as shown in the drawings, is formed of a material opaque to X-ray emanations, such as lead glass, or the tube may be enclosed in any desired form of container which is opaque to these emanations. As indicated, the tube is provided with an upwardly directed opening 193 through which the X-rays pass, and a hollow sleeve 195 extends downwardly from the carriage and provides an opening to confine the X-rays to the proper path. A screen and plate holder is supported upon the carriage above the table, and to this end a bracket 200 is secured to the frame 175 and slidably receives parallel supporting members 202 which carry a screen and plate frame indicated at 204 upon their upper ends. These members are rigidly connected at their upper and lower ends by heads 206 and 207, and are provided with rack teeth 208 which mesh with operating pinions 209 and 210 journaled within the head 200. The pinion 209 is mounted upon a shaft 212 provided upon its outer end with a knurled handle 214 by which the pinion 209 and the intermeshing pinion 210 may be rotated in opposite direc-

tions to move the standards in the desired direction. In order to lock the standards and the screen frame carried thereby in any desired adjusted position with respect to the table, a simple and convenient locking mechanism is provided as indicated in Figure 11. It will be observed from an inspection of this figure that the pinion 210 is loosely journaled upon a hub 215 formed as a part of a sliding pin 216, having a handle 218 on the outer end. This pin is locked against rotation relative to the supporting casing by a stud 220 received in a longitudinal slot on the pin. The hub 215 is provided with a series of longitudinal slots 222, as shown, which are adapted to receive a pin 224 projecting inwardly from the gear 210 in one position of the member 215. The hub 215 is also provided with a peripheral groove 226 within which the pin 224 is freely movable. With this construction when the hub 215 is locked in the position shown in Figure 11, the pinion 210 is freely rotatable thereon, but when the hub 215 is moved to the right, the pin 224 engages in one of the longitudinal slots 222 locking the gear against rotation, and in consequence holding the standards 202 in adjusted position. The plate frame 204 is supported by the standards in such a manner that it may be readily adjusted into any desired angular position with respect to the table while maintaining the center of the screen carried thereby in alignment with the anode or center of the tube. This permits the proper position of the screen to be secured in making X-ray examinations, for example, of a very stout patient. To this end the head 206 carries a yoke 230 which is swivelled upon a stem 232, projecting inwardly over the table from the head, as indicated in Figure 15. This stem 232 is secured in a hub 234, which is journaled upon a pivot pin 236, and held in adjusted position by a clamping screw indicated at 238. The yoke 230 is locked against swivelling movement to the stem 232 through a clamping member indicated at 240. Through the provision of these two adjustments, the yoke may be swivelled about the axis of the stem 232.

From an observation of Figure 16 it will be noted that the hub 234 is provided with stop faces 235 and 237 respectively, which are adapted to engage with a web 239 formed upon the support to retain the yoke and screen frame carried thereby in either a position parallel to the table or normal thereto. In the parallel position, as shown in the drawings, the screen projects over the table and in the vertical position the screen is displaced out of the way, as for example when in employing a source of X-ray above the patient. The screen and plate frame 204 is pivoted between the opposite

arms 242 of the yoke in such a manner that the frame may be readily removed and turned through an angle of 90° and re-inserted between the arms of the yoke. This quickly detachable connection between the frame and the yoke, and the provision for supporting the frame in two different positions, is important because it permits the use of a smaller screen than otherwise.

In the illustrated embodiment of the invention, a fluoroscopic screen having dimensions approximately 11 x 15 inches is employed, with the long dimension normally extending lengthwise of the table, and the short dimension transversely of the table. This ordinarily suffices for all examinations which it is desired to make. In certain instances, however, it may be desirable to cover a space transversely of the table greater than that embraced in the width of the screen, and in this case the position of the screen may be changed so that the long dimension extends transversely of the table. As screens of this type are expensive, the use of this type of connection permitting a smaller screen than otherwise, is a distinctly valuable feature of the present invention.

Upon referring to Figures 15 and 16 of the drawings it will be observed that the opposite sides of the frame 204 are provided with bosses 244 and 246 respectively, each of which carries a stud 248. The outer end of this stud is provided with a reduced threaded portion 250 (see Figure 17) which receives a clamping nut 252. In addition the end 250 is slotted longitudinally at 254, and a collar 225 slides upon the stem provided with a pin 256 engaging within the slot. This collar is normally forced outwardly by a spring 258, but when forced inwardly by the clamping nut 252 is adapted to seat in a recess 260 formed in the bosses 262 in the outer ends of the arms 242. These bosses 262 are also provided with open sided passages 264 which receive the stems 248. With this construction, the frame is inserted between the arms of the yoke and the stem 248 positioned within the open sided recesses 264. Thereafter the clamping nuts 252 are turned to force the collars 225 into the recesses 260, thus retaining the studs in position within the bosses. By tightening the clamping nuts 252 until the bosses 244 are pressed tightly against the arms of the yoke, the frame is held rigidly in position without turning. When it is desired to move the frame, this can be readily accomplished by backing off the nuts 252 until the collars 225 are released from the recesses by the cooperating springs, thus permitting the frame to be dropped out from the yoke and re-inserted in a new position. The detachable connections above described also permit the screen

to be adjusted into different angular positions with respect to the supporting yoke, as will be obvious to those skilled in the art. The handling of the frame is conveniently accomplished by the operator through the medium of knobs 266, of lead or other material, mounted upon the upper portion of the frame, as indicated. This frame carries the screen upon which the image is cast, and in addition a protective shield of lead glass above the screen, which permits a view of the image but protects the eyes of the operator from the X-ray emanations. In addition, the frame is provided beneath the screen with a pocket which slidably receives a cassette or plate holder indicated at 270. The location of the plates immediately beneath the screen and at approximately the same distance from the source of X-ray is important, as it insures that the radiographic plates cover the same field as that shown upon the screen.

The present invention is provided with mechanism for adjusting the dimensions of the shutter opening to produce any desired size of image whatever the position of the screen and plate with respect to the source of X-ray. To this end a stationary dial 272 is mounted upon an extension of the head 200 where it is conveniently visible to the operator, and cooperates with the shutter controlling mechanism. In addition the standards 202 are graduated, as shown in Figure 1, to indicate the distance of the screen frame from the source of X-ray. Upon referring to Figure 12, it will be noticed that the dial 272 is provided with a table termed "Active field" which is so arranged that knowing the height of the screen frame as indicated by the graduations on the standards, the width and length of the shutter opening may be determined for any given dimensions of image. With the width and length of the shutter opening known, the controlling mechanism may be accordingly manipulated to the desired degree. Cooperating with the dial are two indicator hands 274 and 276 which are connected respectively with the two sets of shutters controlling the width and length of the opening. These indicator hands are independently secured to tubular shafts 278 and 280 which are rotatable upon a stationary post 282. The shafts are connected at their upper ends with knurled operating handles 284 and 286, respectively, and are so arranged that the shafts may be turned together or independently, as desired. To this end, the shaft 280 slides upon the shaft 278 until a detent pin 290 carried upon the handle 284 engages within a recess 292 formed in the handle 286 locking both handles together. In this position both shafts and indicating hands are turned together to operate the shutters jointly. When the handles are released,

however, a spring 294 interposed between the handles tends to move them into the relative position shown in Figure 13, in which position either handle may be moved independently of the other to give the proper independent adjustment of the shutters, as indicated by the position of the hands with respect to the graduations upon the dial. Each indicator hand is connected with a set of shutters to open or close each set, according to the direction in which the hand is moved. One pair of shutters is indicated at 300 and 302, and a second pair of shutters, moving at right angles thereto, is indicated at 304 and 306. The shutters 300 and 302 are supported above the shutters 304 and 306, and as indicated in Figure 9, the shutter 300 is supported at one end upon a bar 308, and the shutter 302 is supported at the opposite end upon a bar 310. The two bars 308 and 310 are pivotally connected at opposite ends to centrally fulcrumed levers 312 and 314 in such a manner that as the levers are rocked about their axes, the bars 308 and 310 are moved in a lengthwise direction, always maintaining their parallel relation to increase or decrease the space between the shutters carried thereby, as will be evident. In order to secure the requisite movement of the frame, the bar 310 as shown is connected to the corresponding indicator hand through a connecting rod 316, and a pivot lever 318. The under shutters 304 and 306 are moved toward and from one another in a similar manner, but at right angles to the direction of movement of the shutters 300 and 302. For this purpose the under shutters, as shown, are mounted upon parallel bars 320 and 322, pivotally connected at opposite ends to levers 324 and 326. The frame carrying these shutters is moved the desired amount by a connecting rod 328 connected at one end with the corresponding indicator hand and at the other end to the pivoted lever 330 which is connected in turn to the lever 326 through a pin 327 and cam slot 329 formed in an extension 331. It will be obvious to those skilled in the art that with this construction the shutters may be simultaneously or independently adjusted to provide a rectangular opening of the requisite size to produce an image of the desired dimensions upon the radiographic plate or screen.

As the weight of the table and mechanism supported thereby is considerable, it is quite essential that some means be provided for accurately counter-balancing the table and connected mechanism in any longitudinal position of the tube carriage. In order to effect this result, the stationary transformer 371 is designed to accurately counter-balance the table itself in any inclined position. It will be observed from an inspection of Figure 1 that with this end in

view the transformer is mounted upon the right hand end of the table to compensate for the greater weight of the table to the left of the pivot bearing. The weight of the tube carriage and correlated parts is counter-balanced in any position of the carriage by a counter-weight connected therewith and movable in the opposite direction. Upon referring to Figures 2 and 19 of the drawings it will be seen that the table is provided with a hollow tube 340 within which slides a counter-weight 342 which may have anti-friction bearings as shown clearly in Fig. 19. The opposite ends of the counter-weight are connected respectively with opposite ends of the tube carriage through flexible cables 344 and 346, which pass about pulleys 348 and 350 journaled respectively in the tube 340 and the end casings 99 and 101, as shown clearly in Figure 19. In order to maintain the cables taut and avoid any shock or jar in moving the carriage, one of the cables is connected to the carriage through a spring connection as indicated generally at 352 in Figure 18. This connection comprises a casing 349 threaded upon a connector stud 351 and receiving a spring 353 which forms a yielding connection between the cable and casing 349. When the carriage is in the position shown in Figure 2 of the drawings at one end of the table, the counter-weight 342 is located within the tube at the opposite end and as the carriage is moved downwardly in the drawings the counter-weight is moved in the opposite direction a like distance. With this construction in actual practice the table may be rocked when the motor is disconnected with a very slight pressure.

As will be observed from an inspection of Figures 1 and 2 of the drawings, the X-ray tube is connected with the transformer through connections designed to automatically take up or pay out as the tube carriage is moved relative to the transformer. To this end the filament end of the tube is connected to the transformer by leads 360 and 362. These leads at the tube end pass over spring sheaves 364 and 366, as shown in Figure 2, which constantly tend to rotate in a direction to maintain the leads taut. Thus, as the tube carriage is moved toward the transformer, the sheave members 364 and 366 rotate to wind up the leads, and as the tube carriage is moved in the opposite direction, the members are rotated against the tension of the spring to pay out the leads. The opposite end of the tube is also connected with the transformer through a lead indicated at 367, which passes over a similar sheave 368 and from this point to the tube through a flexible connection 370. The cathode member is connected to the transformer 371 through a stationary conductor 372, passing into the bottom of the trans-

former box. It will be observed that with this construction the high tension leads connecting the transformer with the tube are located beneath the table in a position where there is no liability of the operator coming in contact with them. To provide an additional safeguard, the tube is provided with two guard rails 374 and 376 which are connected at opposite ends to the operating segment 17 and to an outwardly projecting arm 378, as shown in Figure 1. The tube is housed on opposite sides by plates 379 of bakelite or similar insulating material.

Means are provided for conveniently controlling the operation of the tube, and to this end a resistance control for the filament is located in a position conveniently accessible to the operator. Upon referring to Figures 1, 2 and 31, it will be seen that a resistance 380 is mounted upon a plate 382 supported by the transformer box, this resistance being connected into the filament circuit. The control of the resistance is secured through a movable contact member 384, which is mounted upon a rotatable lead screw 386 journaled in brackets 388 and 389. The lead screw projects diagonally upward into a position where it may be manipulated by an operator standing at one side of the table. The upper end of the screw is provided with an operating handle 390 by which it may be rotated to traverse the contact 384 lengthwise of the resistance. It will be observed, upon referring to Figure 31, that the lead screw is provided with a thread of steep pitch so that a slight rotation of the handle will cause a comparatively large movement of the contact. In addition to this convenient method of control, the table is provided with means for instantly rendering the tube inoperative, if so desired. To this end an operating cord indicated at 392 extends along the front of the table, as shown in Figure 1, and is connected with a pull switch 394 of any usual type, which, when operated by a pull upon the cord, disconnects the tube circuit. It will be observed that this operating cord extends throughout substantially the entire length of the table so that it may be conveniently manipulated in any position of the operator. The transformer carries a milliammeter 373 which indicates to the operator the current consumed.

The table, as thus far described, is adapted for X-ray examinations or the taking of radiographs with the tube located beneath the table. In addition, it is desirable to provide means for taking stereoscopic radiographs, and this is preferably accomplished in the present invention by a second tube supported above the table and plates supported beneath the table adapted to record the desired image. The plate holder carrying the plates for this purpose conveniently

receives two plates, and is adapted to be quickly shifted from one position to another to permit the taking of the two radiographs which are usual in this class of photography. The plate changing mechanism is so designed that when released it will shift automatically from one position to another. This is accomplished by providing spring connections which are normally adapted to move the plate holder into one position. The weight of the holder is such, however, that when the table is in a vertical or substantially vertical position, gravity will cause it to operate against the springs. A plate carrying frame 400 is accordingly supported for movement between the two angle irons 137 upon which the bed of the table is mounted. This plate carrying frame and the construction for supporting and shifting it are shown more particularly in Figures 17 to 25, inclusive, of the drawings. As will be observed from an inspection of Figures 21 and 22, a rectangular wooden frame 402 is designed to receive two plates end to end, a distance piece 404 serving to separate the two plate holders. The upper face of the plate carrier is provided with metal strips 406 which enclose an opening of the desired size and provide an inwardly projecting ledge for retaining the plate holders in position. The opposite side of the plate carrier 400 is provided with quarter round mouldings 408 located within the opening and adapted to hold the plate holders in position against the ledge in conjunction with a spring latch 410. Upon referring to Figure 22, it will be obvious to those skilled in the art the manner in which the plate holders may be thrust into the opening and held in place. The plate carrier 400 is provided upon its opposite sides with tongues 412 having recesses 414 which receive a horizontal flange 416 formed upon supporting angles 418 secured to the main supporting irons 137, as shown in Figures 25 and 26. This construction provides parallel tracks along which the plate carrier may slide immediately beneath the bed of the table. The plate carrier is normally retained in one position by tension springs 419 and 420, which connect a bar 422 secured to one end of the frame with a transverse bar 424 rigidly connected to the end casting 99. In addition mechanism is provided for locking the plate carrier in one of two positions, and for conveniently releasing the carrier to permit it to be shifted by the springs to a second position. To this end the plate carrier is provided with a transversely projecting handle 426 carrying a head 428 which slides upon a stationary tube 430, as shown clearly in Figures 1 and 24. This tube is provided with two openings 432 which correspond respectively to the two positions of the plate carriers. These recesses are adapted to be

engaged by the inner end of a locking plunger 434 slidably supported within the head, and normally moved into locking position by a spring 436 received within a recess in the head and enclosed between the plunger and a cap screw 438, as shown in Figure 26. When in locking position, the inner end of the plunger 434 projects in the tube sufficiently to be engaged by the wedge shaped ends of the releasing members 440 and 442 connected to a releasing rod 444, which slides within the tube. The releasing rod extends substantially throughout the length of the table, being slidably supported at opposite ends by brackets 446. The opposite ends of the rod are provided with handles 448 and the rod is normally retained in an inoperative position, as shown in Figure 24, by a spring 450. The operation of the above described construction is substantially as follows.

After the plate holders have been inserted within the plate carrier, the latter is moved by the handle 426 into a position in which the springs 420 are tensed and locked in this position for engagement of the detent of the corresponding opening in the tube. After the first radiograph has been taken in this position, the releasing rod is moved lengthwise to elevate the plunger sufficiently in the opening to cause the wedge-shaped end of the plunger to engage with the walls of the opening and thereafter the strength of the spring 420 is sufficient to complete the unlocking movement of the plunger, and immediately shift the plate carrier as a whole into the second position. The plate carrier is then locked automatically in this position by the engagement of the plunger with the second opening in the tube. When the table is locked in a vertical or substantially vertical position, however, the first picture is taken with the plate holder in the second position, as above described. Thereafter the locking means are released to permit the weight of the plate holder to move it into the first position by gravity against the action of the springs. It will be obvious to those skilled in the art that the locking means are so designed that they will firmly hold the plate holder in either one of two positions, irrespective of the inclination of the table. By operating the plate holder in this manner it is not necessary to employ as powerful a shifting mechanism, and the resultant shock and jar are largely reduced.

In order to prevent the shock which would normally be incident to the rapid shifting of the plate carrier, means are provided for checking the movement of the carrier at the completion of the shifting movement. To this end a hollow cylinder 452 is secured to the front of the table adjacent the releasing rod, as shown in Figure 24, and receives a piston 454, connected with a piston

rod 456 slidably received in a bracket 458. The piston rod is provided with spaced collars 460 and 462 which are adapted to be engaged by the head 428 when moving the plate carrier longitudinally. The cylinder 452 is closed at the opposite ends, but is provided with a relief opening controlled by a suitable form of spring operated valve 464. As shown in Figure 27, the valve 464 comprises a needle valve 466 controlling a small opening 468 which enters the cylinder adjacent the closed end. This construction forms in effect a dash pot which serves to check the movement of the plate carrier in either direction when near the end of its stroke. When the plate carrier is moved in one direction through the handle 426, the engagement of the handle with one of the collars moves the piston 454 to the right, as shown in Figure 23, and thereafter the plate carrier is released and the returning movement due to the springs causes the head to engage with the collar 462 near the end of the stroke and actuate the dash pot to check the movement and bring the plate carrier gently into position.

The overhead tube employed in connection with the stereoscopic plate holder is mounted above the table upon a vertical standard 470. This tube, which may be of any usual form (not shown) is preferably adjustable with relation to the standard into any one of a number of angular or vertical positions. The tube carrying standard 470 is supported by brackets 472 and 474 which travel upon upper and lower guide rails 476 and 478 connected at their opposite ends to supports 480 and 481, all as shown in Figures 1 and 2. The brackets 472 and 474 are each provided with three anti-friction rolls 486 which engage with opposite sides of the tubular guide rails 476 and 478 to facilitate the movement of the brackets thereon. This construction permits the overhead tube to be conveniently moved into any position longitudinally of the table. As will be observed from an inspection of Figure 2, the supports and tubular guide rolls are connected with the side support 13 through connections 490.

Having thus described the invention, what is claimed is:

1. An X-ray apparatus comprising a supporting member, a table pivotally connected with the supporting member at a point unequally distant from the opposite ends, a transformer supported by the table in a manner to counter-balance the latter, a source of X-ray supported by the table and movable with relation thereto, and means for counter-balancing the source of X-ray in any position of the latter with respect to the table.

2. An X-ray apparatus comprising supporting members, a table connected thereto near one end for rocking movements, an X-

ray tube carried by the table, and a transformer mounted upon the table to counter-balance the table in its various positions.

3. An X-ray apparatus comprising a screen frame, threaded studs projecting from opposite sides of the screen frame, a yoke having open sided stud receiving passages in the ends of the arms, collars slidably supported upon the studs, and means for forcing the collars into locking recesses formed in the passages to clamp the frame between the arms of the yoke.

4. An X-ray apparatus comprising a supporting yoke having open sided passages formed in the ends of the arms, a screen frame, threaded studs projecting from opposite sides of the screen frame, and means for locking the studs in the open sided passages formed in the arms of the yoke, adapted to permit the frame to be adjusted angularly with respect to the yoke.

5. An X-ray apparatus comprising a pivoted table, a carrier adapted to contain two plate holders, means for slidably supporting the carrier, mechanism for locking the carrier in an operative position, spring mechanism for normally moving the plate carrier to a second operative position upon release of the said locking mechanism, means for locking the carrier in the second position,

the plate carrier having sufficient weight to allow of motion from the second position to the first mentioned position against the action of the spring mechanism when the table is upright.

6. An X-ray apparatus comprising a table, a carriage movable longitudinally of the table, a yoke mounted on the carriage, a rectangular screen adapted to be supported by the yoke and having a boss on each side of such length that the screen may be supported in the yoke either longitudinally or transversely of the table, and means for connecting two opposite bosses in the arms of the yoke.

7. In combination, a support, a table rotatably mounted on said support and adapted to be tilted through a vertical arc, an X-ray tube mounted on said table and a transformer mounted on said table below the axis of rotation thereof and connected to said tube.

8. In combination, a support, a table rotatably mounted on said support, a carriage movable longitudinally of said table, an X-ray tube mounted on said carriage, a transformer mounted on the rear side of the table at the lower end thereof and conductors connecting the transformer with the tube.

CHARLES E. CAMPBELL.