Feb. 4, 1958 A. J. KIZAUR 2,822,477

X-RAY APPARATUS

Filed Nov. 16, 1951 5 Sheets-Sheet 1

FIG. 1

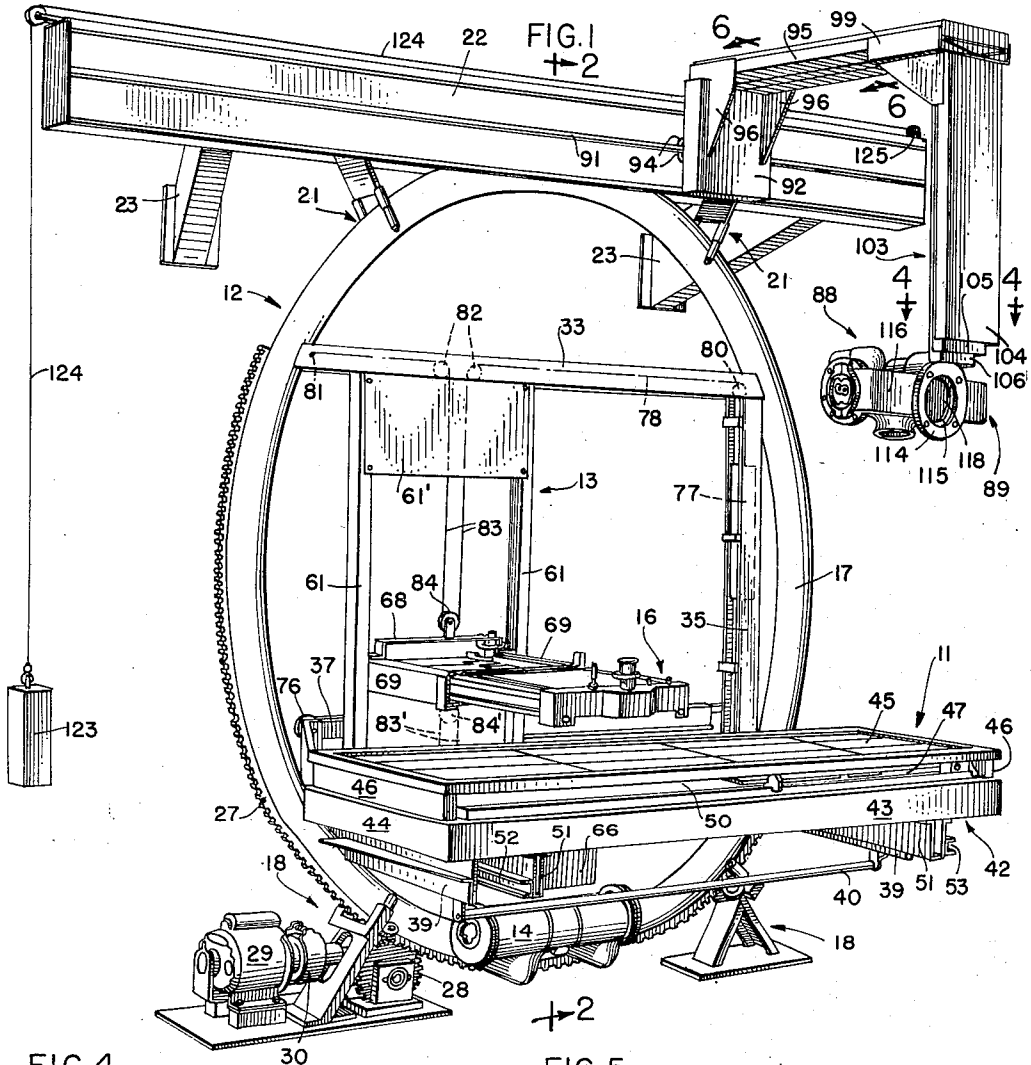


FIG. 4

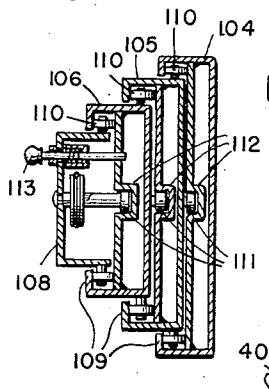


FIG. 5

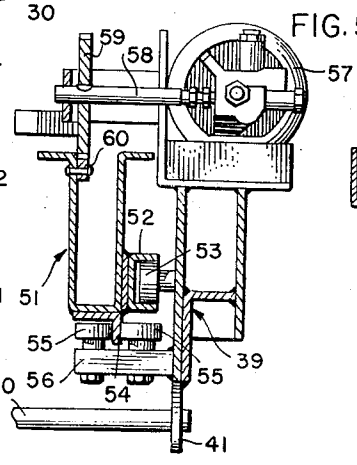
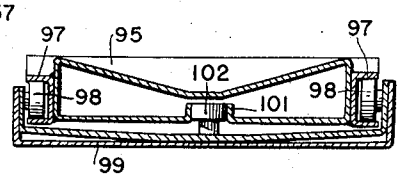


FIG. 6



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X-RAY APPARATUS

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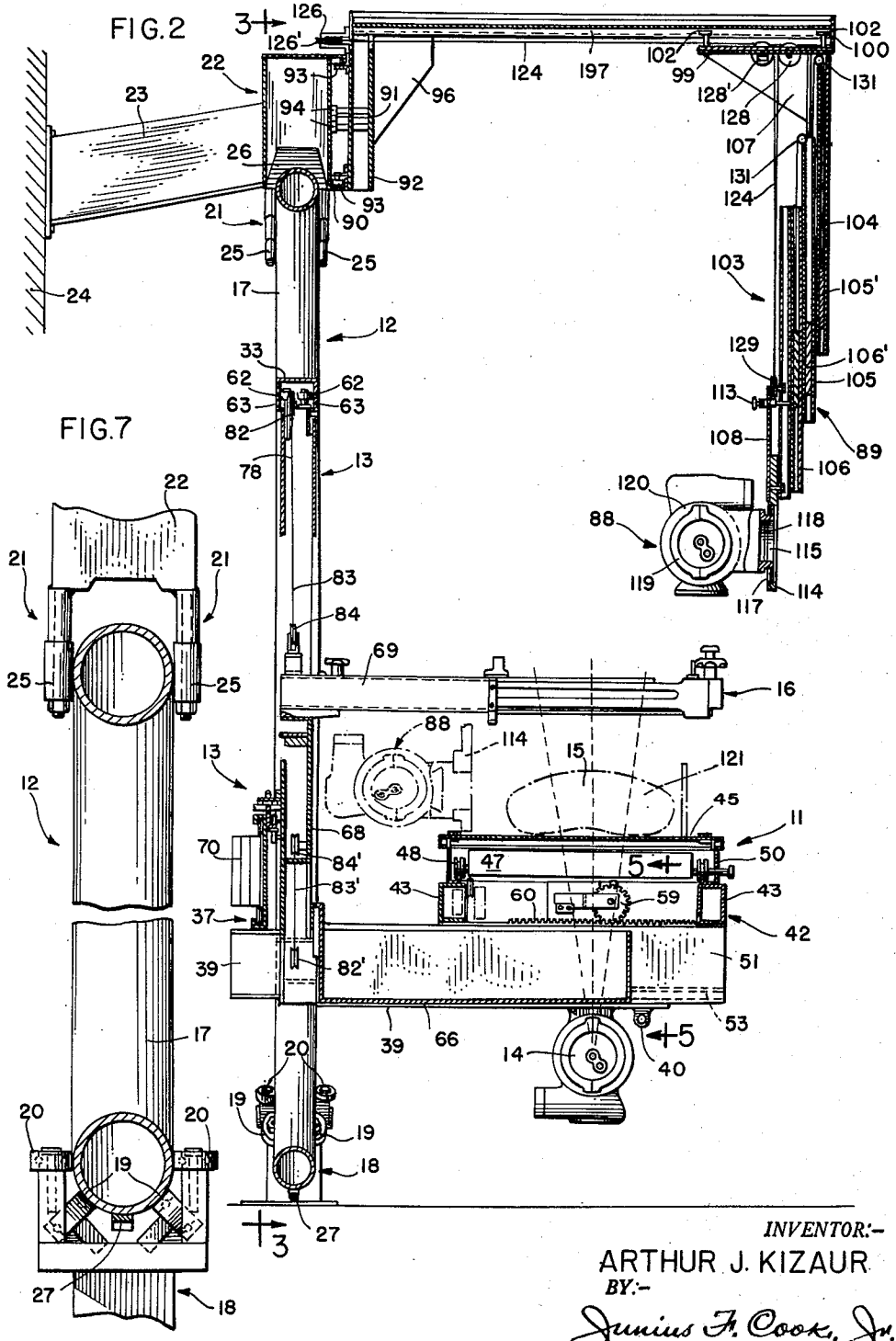
FIG.2



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X-RAY APPARATUS

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FIG. 3

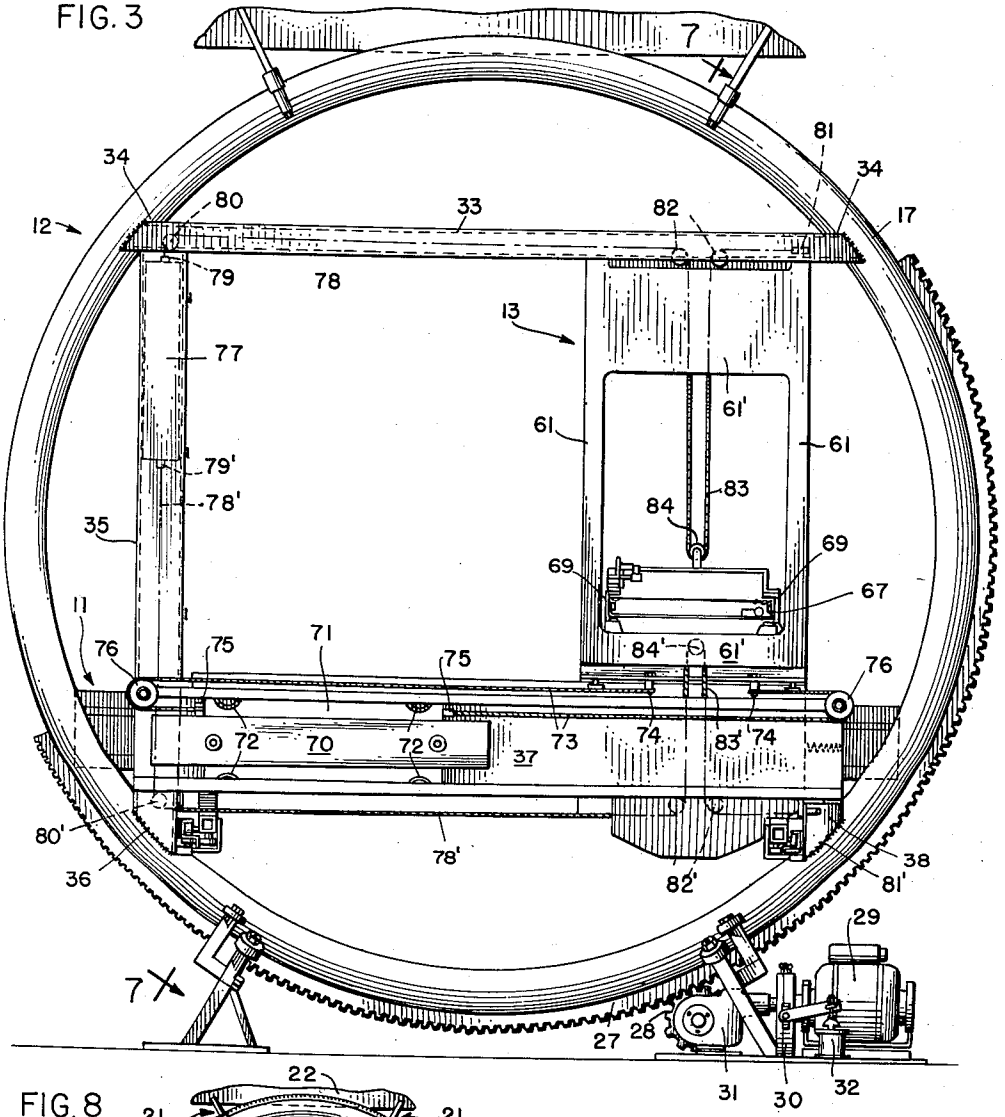
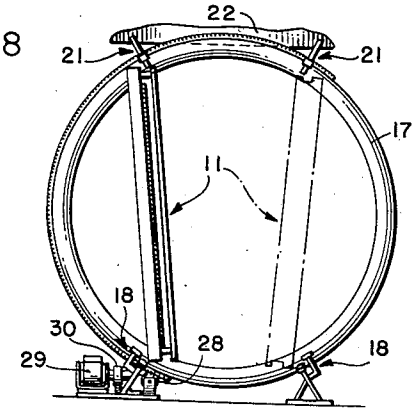


FIG. 8



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X-RAY APPARATUS

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FIG. 9

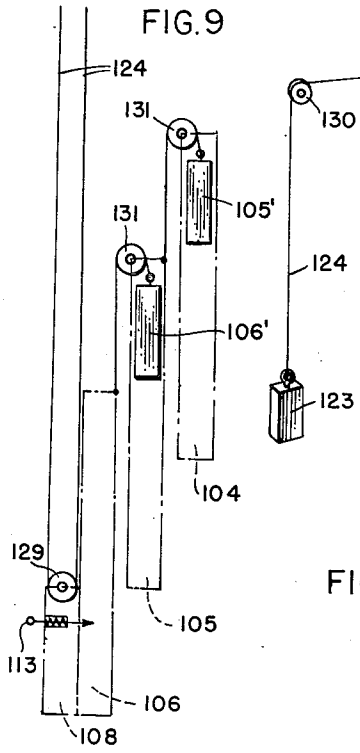


FIG. 10

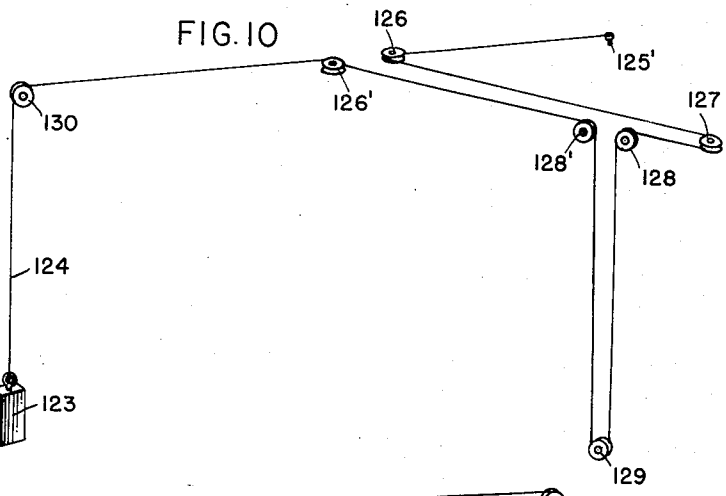


FIG. 11

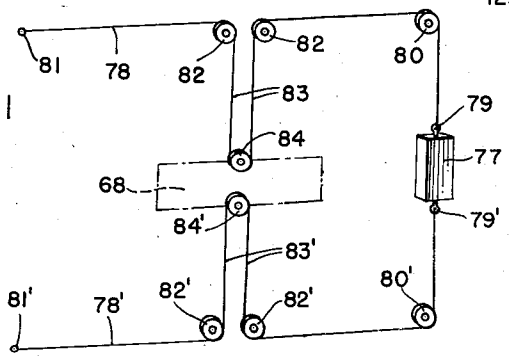


FIG. 12

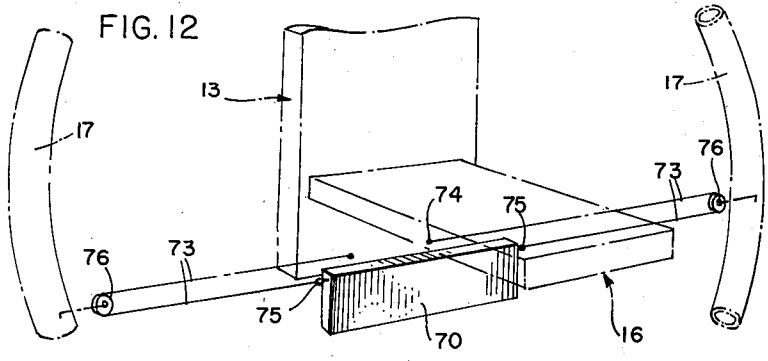
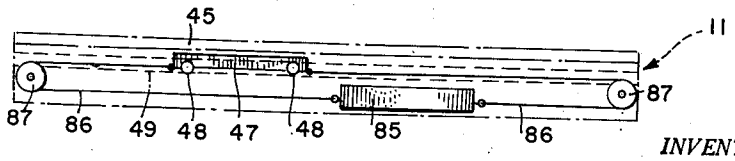


FIG. 13



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X-RAY APPARATUS

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FIG. 14

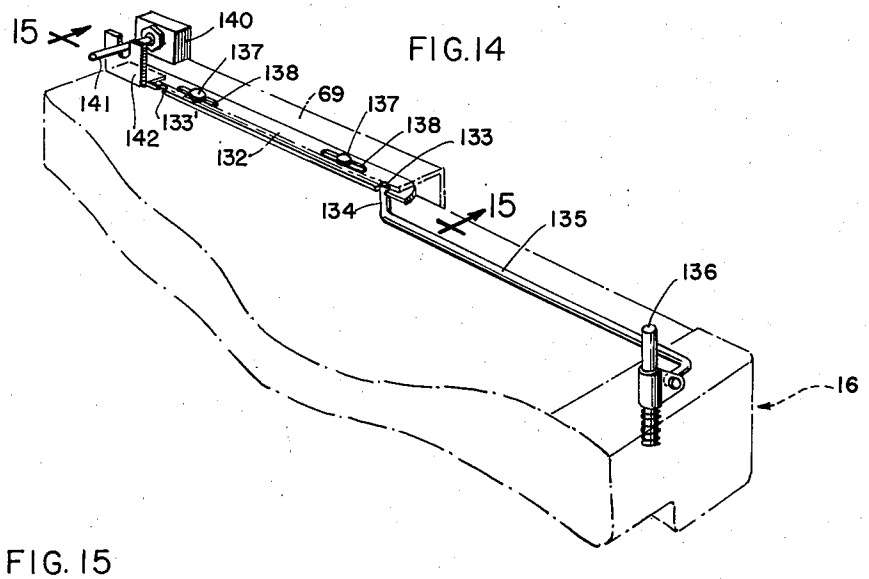


FIG. 15

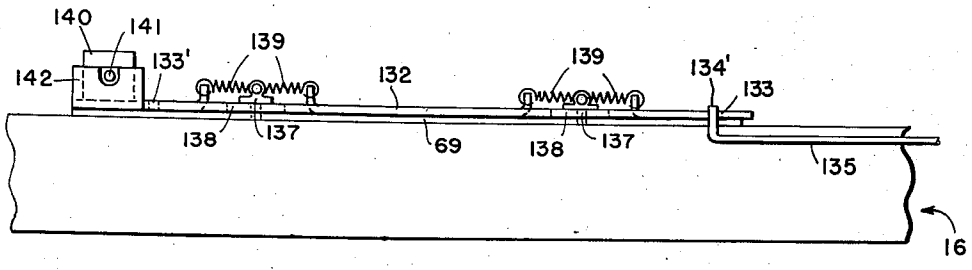
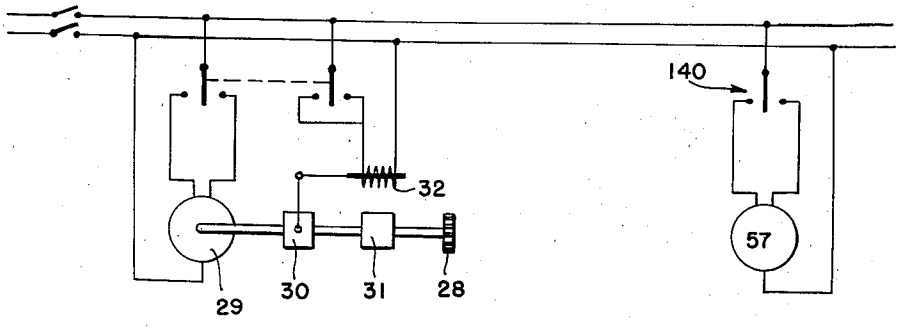


FIG. 16



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United States Patent Office 2,822,477 Patented Feb. 4, 1958

2,822,477

X-RAY APPARATUS

Arthur J. Kizaur, Wauwatosa, Wis., assignor to General Electric Company, a corporation of New York

Application November 16, 1951, Serial No. 256,801

14 Claims. (Cl. 250—57)

The present invention relates in general to X-ray apparatus particularly adapted for use in connection with the X-ray examination, treatment and picturing of objects, especially the bodies of human patients, the invention having more particular reference to an improved tilting table structure well adapted for use in supporting human and other bodies, selectively, in vertical, horizontal and intermediate tilted positions to facilitate X-ray examination, photography, and treatment of the so supported bodies.

In the making of X-ray pictures or radiographs of human bodies, as well as in the fluoroscopic examination of patients, it is necessary to provide suitable means for supporting the body of the patient in desired position between a suitable source of X-rays and an X-ray sensitive viewing screen, for fluoroscopic examination, or an X-ray sensitive film, in making X-ray pictures. It is also highly desirable, in some circumstances, to be able rapidly to change the inclination at which the object being pictured or examined is supported; and to provide for the picturing of the examination object, or a desired portion thereof, as quickly as possible after the desired picture subject matter shall have been determined by fluoroscopic examination. It is therefore desirable to provide a table structure, in conjunction with auxiliary equipment including X-ray generating tubes, X-ray sensitive fluoroscopic viewing screens, and X-ray sensitive film carriers, for supporting the body of a patient in position for X-ray examination, picturing, and treatment; and to provide for the rapid adjustment of the examination or picture subject, as well as the auxiliary equipment, to desired examining or picturing positions.

As indicated in United States Letters Patent No. 1,599,696, of September 14, 1926, on the invention of Julius B. Wantz; No. 1,874,582, of August 30, 1932, on the invention of Albert C. Nelson; No. 2,038,327, of April 21, 1936, on the invention of Julius B. Wantz; and No. 2,315,786, of April 6, 1943, on the invention of Julius J. Grobe, it has heretofore been the practice to provide tilting tables for receiving and supporting the object to be examined, pictured, or treated, such tables carrying auxiliary equipment including X-ray generating tubes, fluoroscopic screens, and sensitive film carriers on and adjustable with respect to the tiltably supported table structure. As pointed out in United States Letters Patent No. 2,568,236, of September 18, 1951, on an invention of Arthur J. Kizaur, it is desirable, if not essential, to provide adequate rigidity in the table structure so that the table, even when heavily loaded and tilted, will support its load precisely in desired position for treatment, examination, or for picturing the supported object.

In order to provide adequate rigidity, it has heretofore been necessary to employ relatively heavy, ponderous structures for support table purposes, although heaviness and consequent inertia is, of course, undesirable in structures requiring rapid adjustment, on occasion, it being desirable to provide table structures, as well as screen

and film carying structures and X-ray generating tube mountings, of minimum weight, not only in the interests of rapid adjustment but to minimize the physical effort required upon the part of the operator of the equipment in placing the various adjustable parts thereof rapidly in desired positions of adjustment. In that connection, it should be understood that the operator of heretofore available equipment is usually required manually to adjust the film and screen carriages, as well as the X-ray generating tube on its support, such operations in prior equipment requiring considerable physical effort on the part of the operator of the equipment.

The present invention represents a new approach toward the provision of X-ray equipment including tiltably adjustable table means and associated adjustable equipment for radiography, fluoroscopy and X-ray therapy, wherein adjustment of the apparatus may be accomplished extremely rapidly and substantially without effort upon the part of the operator of the equipment.

An important object of the present invention is to provide a strong and rigid, yet relatively light weight table structure supported in novel fashion, so that the table may be adjusted rapidly and with minimum effort to any desired angularity about an axis of adjustment; a further object being to mount the table in a frame supported for turning movement about a medial axis, whereby the table may be freely turned with its supporting frame to any desired angularity; a still further object being to form the frame in fashion providing a ring-like track, and to mount the same for turning movement on suitable support rollers.

Another important object is to form the table support frame as a continuous ring supported for turning movement about the central axis of the ring, the table structure being mounted on the ring for turning movement therewith; a further object being to employ a ring comprising a light weight hollow pipe.

Another object is to mount the table in its supporting frame, and to separately mount, on the frame, adjustable carriage means for supporting radiographic or fluoroscopic equipment for use in conjunction with the table; a further object being to mount such equipment for adjustable movement, in the frame, longitudinally of the table, as well as toward and away from the table; a still further object being to mount the table structure, in its supporting frame, for adjusting movement with respect to said equipment, in a direction transversely of the table structure; yet another object being to arrange the several parts, on the support frame, so that the turnable structure is substantially balanced about its axis of turning movement, whereby the entire structure may be adjusted about said axis with minimum effort.

Another important object of the invention is to provide an adjustably tiltable table structure for radiographic, fluoroscopic and X-ray therapy purposes, wherein the table element may be adjusted, in the tiltable table support structure, in a direction laterally of the table.

Another important object of the invention is to provide X-ray source means, together with fluoroscopic screen and film carriage means, adjustable, in the tiltable table support structure, in a direction longitudinally of the table, the screen and film carriage means being also adjustable toward and away from the table, including counterbalancing means so formed and arranged in the table support structure as to balance the weight of the adjustable means about the turning axis of the table support structure, for all adjusted positions of the adjustable means therein.

Another important object is to provide a structure of the character mentioned including a turnable support frame of ring-like character, a table structure mounted on the ring-like member, on one side thereof, driving means for adjustably shifting the table structure toward

and away from the ring-like member, carriage means for supporting an X-ray generator tube beneath, and X-ray sensitive screen or film material above, the table structure, such carriage means being movable on the ring-like member, longitudinally of the table structure, substantially throughout the length thereof, and motive means controlled by pressure exerted on said screen or film carrier in one direction or another for adjustably shifting the table structure, on the ring-like member, in a direction transversely of the table structure, depending upon the direction of manual pressure exerted on the film or screen carriage.

Another important object is to provide novel light weight and counterbalanced means for supporting an X-ray generator tube, said means being adjustable to permit the supported tube to be disposed in any desired position and at any desired inclination with respect to an object to be pictured; a further object being to provide a tube support embodying a plurality of telescopically arranged members, each successively counterbalanced upon the next adjacent member and all counterbalanced on a suitable support stand for the purpose of supporting the generator tube in fashion allowing for the substantially effortless manipulation thereof.

The foregoing and numerous other important objects, advantages, and inherent functions of the invention will become apparent as the same is more fully understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a perspective view showing X-ray apparatus embodying the present invention;

Figs. 2 and 3 are sectional views respectively taken substantially along the lines **2—2** in Fig. 1 and **3—3** in Fig. 2;

Figs. 4 and 6 are sectional views respectively taken substantially along the lines **4—4** and **6—6** in Fig. 1;

Figs. 5 and 7 are sectional views respectively taken substantially along the lines **5—5** in Fig. 2 and **7—7** in Fig. 3;

Fig. 8 is a fragmentary front view of the apparatus;

Figs. 9, 10, 11, 12 and 13 are schematic views illustrating the manner of counterbalancing the several adjustable components of the apparatus;

Fig. 14 is a fragmentary view of a portion of the apparatus;

Fig. 15 is a sectional view taken substantially along the line **15—15** in Fig. 14; and

Fig. 16 is a wiring diagram of electrical equipment for accomplishing the controlled adjustment of the apparatus.

To illustrate the invention, the drawings show X-ray apparatus including an adjustable table structure particularly well suited for supporting human bodies in position for X-ray examination and therapy, or for the making of X-ray pictures of the supported body. The structure is especially well suited for such purposes in that the table structure is tiltably supported for adjustment to any desired angularity about a central turning axis, so that a supported body may be disposed in horizontal and in any position tilted from horizontal in either direction, the table structure being tiltable to dispose a body supported thereon in vertical position in either direction. Indeed, if desired, the table structure could be disposed in any desired inverted angular position, although table inversion is not ordinarily desirable or necessary.

To these ends, the apparatus comprises a table structure **11**, turnably supported means **12** carrying the table structure, and frame means **13** mounted on the support means for movement thereon longitudinally of the table structure **11**, such frame means **13** carrying an X-ray generating tube enclosed in a suitable casing structure **14**, in position beneath the table structure **11** to direct a beam of X-rays upwardly through the table structure and a body **15** disposed thereon in position for examination or therapy, or to be pictured. The frame means **13** also provides for the support thereon of a frame structure **16** adapted to carry X-ray sensitive fluorescent screen means, or X-ray sensitive film material, in position above the table structure **11**, to allow for the fluoroscopic examination or the radiographic picturing of the supported body **15** when irradiated with X-rays from the ray source in the casing **14**. It will be seen that the ray source in the casing **14** and the frame means **16** may be moved simultaneously and in fixed relative position longitudinally of the table structure **11**, thereby allowing for radiography or fluoroscopy of the subject body **15** in any selected zone longitudinally of the table structure merely by moving the frame means **13** to an appropriately adjusted position longitudinally of the table structure.

The turnable support means **12** preferably comprises a hollow tubular member **17** forming a continuous circular ring, the ring being supported in a substantially vertical plane for turning movement about its central axis. To this end, the lower portions of the ring may be supported in a pair of spaced bearing structures **18** comprising frames, which may be anchored in spaced position on the floor of the building in which the X-ray apparatus of the present invention is installed for service. Each of the frames **18** may carry a pair of inclined rollers **19** adapted to rollingly support the tubular ring member **17** thereon; and lateral rollers **20** supported in position to engage the opposite sides of the ring member to retain the same in supported engagement with the rollers **19**.

In order to support the ring member **17** in a substantially vertical or upright position on the bearing structures **18**, one or more guide bearing structures **21** may be provided in position engaging the upper portions of the member **17**, the bearing structure or structures **21** being preferably mounted in an elongated frame, preferably comprising a beam structure **22** which may be carried on mounting arms or brackets **23**, anchored as on a supporting wall **24**, which may comprise a part of the building in which the X-ray apparatus of the present invention is installed for use. Of course, the beam structure, by means of suitable brackets, may be mounted or suspended from the roof structure of a room in which the equipment is installed for use, rather than on a wall. As shown, the bearing structures **21** may each comprise a pair of spaced apart pins carrying sleeve-like rollers **25** in position to engage the opposite sides of the ring member **17**, said roller carrying pins being firmly mounted on the beam structure **22** and extending downwardly thereof in directions generally radially of the ring member **17**. The beam structure **22** also, if desired, may be of hollow construction, as shown more particularly at **26**, in order to receive the top of the ring member within the beam structure.

It will be seen from the foregoing that the ring member **17** will be supported by the rollers **19**, **20** and **25** for free and unobstructed turning movement to any desired extent and in either direction. Any suitable or preferred means may be provided for so turning the ring member and the equipment, including the table structure **11** and the frame **13** that is mounted thereon. Preferably, however, motor means is provided for so turning the structure. To this end, the ring member may be provided with a circumferential rack member **27** which, if desired, may extend throughout the entire circumference of the ring member. For practical purposes, however, it is necessary to extend the rack member only through slightly more than half of the circumference of the ring member, in providing a structure that may be tilted through a turning movement of 90° in either direction from a normal or medial position, such as the position of the apparatus in which the table structure **11** is horizontal.

In conjunction with the rack **27**, one of the bearing structures **18** may be arranged to provide bearings for supporting a gear **28** in position drivingly engaging the

rack 27, said bearing structure 18 being also preferably arranged to support a preferably electric motor 29 in position drivingly connected with the gear 28, as through a clutch 30 and a driving gear train 31. Electrically operated solenoid means 32 may be provided for controlling the clutch 30 for selectively connecting the motor 29 with the rack driving gear 28. Accordingly, by energizing the motor 29 for driving movement in one direction or the other, and by operating the solenoid 32 for the engagement of the clutch 30, the ring member 17 may be turned in either direction, to thus adjust the relative angular position of the ring member and the equipment mounted thereon, to any desired extent about the central axis of the ring member.

The ring member 17 carries structural members bracing and rigidifying the same and forming support means on which the table structure 11 and adjustable frame means 13 are mounted. These structural members may comprise a channel member 33 extending in chordal relationship with respect to the ring member in position preferably parallel with respect to the table structure, said channel member 33 preferably comprising a formed sheet metal part welded, as at 34, or otherwise rigidly secured at its opposite ends on spaced portions of the ring member. The structure may also include another preferably formed sheet metal channel member 35, extending preferably at right angles with respect to the member 33 and secured rigidly, as by welding or otherwise, at one end to one of the anchored ends of the member 33, the opposite end of the member 35 being welded or otherwise rigidly secured on the ring member, as at 36. A relatively wide channel member 37 is mounted in the structure chordally of the ring member, said channel member 37 at one end being rigidly secured, as by welding or otherwise, to the member 35 adjacent the end thereof that is secured as at 36 on the ring member. The opposite end of the channel member 37 may be secured on the ring member, as by means of a bracket 38, welded or otherwise rigidly secured to the ring member.

A pair of formed sheet metal beams 39, preferably of cantilever type, are rigidly connected in the support structure at the opposite ends of the member 37, said beams extending outwardly of the plane of the ring member in position beneath the table structure 11 to provide support for the same on one side of the ring member. These beams 39, at one end, may be fastened rigidly to and braced upon the channel member 37 at its opposite ends; and the outwardly extending or free ends of the beams 39 may be bracingly interconnected, as by means of a tie rod 40, having opposite ends secured in dependent lugs 41 formed on and adjacent the free ends of the beams 39. The table structure 11 is supported for adjusting movement on the beams 39 toward and away from the plane of the ring-like member 17, in a direction transversely of the table structure.

To this end, the table structure 11 may conveniently comprise a rectangular frame 42 embodying a pair of spaced apart, longitudinally extending members 43 rigidly interconnected in spaced relationship by transverse bracing and spacing members 44 forming the opposite ends of the rectangular frame 42, said members 43 and 44 preferably comprising box-like channel members of metal, such as steel, rigidly secured at the meeting ends of the members, at the corners of the frame 42, although it will be apparent that the invention is not necessarily limited to the particular sectional shape of the frame members. The frame members 43 and 44, of course, may be secured together in any suitable or convenient fashion, as by welding, whereby to provide an exceedingly rigid, yet relatively inexpensive, light weight frame structure, the preferred box-like character of the frame members affording a structure of unusual rigidity.

The table frame 42, of course, may carry a table top panel 45 secured to the frame in any suitable or preferred fashion, as on mounting members 46 at the ends and along one side of the frame, whereby to support the panel in position overlying the top of the frame. Immediately beneath the top panel, the frame 42 may provide a mounting for a cassette and diaphragm carriage 47, the same being provided with bearing wheels 48 in position to ride upon suitable tracks 49 on and extending longitudinally of the side frame members 43, so that the carriage 47 may be shifted to any desired position longitudinally of the frame 42 beneath the top panel 45.

In this connection, it will be noted that the panel 45, at its forward longitudinal edge, remote from the ring-like member 17, is spaced above the frame member 43 to form a slot-like opening 50, through which access to the cassette carriage may be had, the function of the cassette carriage being to removably receive and support a case or cassette adapted to receive, in light tight fashion, X-ray sensitive material. In this connection, the film containing cassette may be introduced edgewise into mounted position in the carriage 47 through the slot-like opening 50. When in mounted position in the carriage, the cassette enclosed X-ray sensitive film may be adjusted longitudinally of the table structure to any desired position for exposure to X-rays through an object to be pictured.

The table frame 42 is supported on a pair of transverse beams 51, preferably of hollow sheet metal construction, which extend between the longitudinal frame members 43, said beams 51 at their opposite ends being secured to said longitudinal members 43 in any suitable or preferred fashion, as by welding the parts together. Each of the beams 51 is provided with track forming means 52. The track forming means 52 conveniently may comprise separately formed channel members secured on the beams 51 by welding or otherwise, as shown clearly in Fig. 5 of the drawings. The track forming means 52 is adapted to receive rollers 53 carried by the support beams 39, whereby the table structure is slidingly supported on the beams 39 by the rollers 53 for movement transversely of the table structure toward and away from the plane of the support ring 17. In addition, each of the beams 51 may be formed with a downwardly extending flange 54 along its lower edge, as by welding or otherwise attaching flange forming angle irons to and along the lower edge of each of the beams 51. These angle irons may be rollingly received between spaced rollers 55 supported on bracket means 56 secured on the beams 39 below the members 51.

Any preferred means, of course, may be employed to shift the table structure on the support beams 39. Preferably, however, a motor 57 may be employed for that purpose. To such end, the motor 57 may be mounted on one of the beams 39 and may, through suitable gearing, be connected to drive a shaft 58 suitably journalled in bearings on the beam 39, and carrying a gear 59 in position to drivingly engage a toothed rack 60 secured on and to one of the table structure supporting beams 51. By operating the preferably electric motor 57 in one direction or the other, the table structure, through the gear 59 and rack 60, may be moved on the beams 39 toward and away from the plane of the ring 17.

The frame 13 preferably comprises a hollow, light weight, sheet metal structure embodying a pair of spaced apart channels 61 suitably braced and spaced by transverse panels 61', some of which, at least, may be of demountable character giving access to the interior of the frame. The frame 13 is fitted with rollers 62 adapted to ride on tracks 63 formed in the chordal member 33, said frame also carrying rollers 64 adapted to ride on tracks 65 formed on the chordal frame member 37, whereby the frame 13 may be moved within the ring member 17 in the longitudinal direction of the table frame.

The frame 13 provides carriage means for the screen and film carrying frame structure 16 and also for the X-ray source 14. To this end, the lower portions of the

frame 13 may carry a box-like beam 66, extending thence beneath the table structure 11 and carrying the X-ray generator and its casing 14 at the frame remote end of the beam. Means is also provided for mounting the frame structure 16 movably in the frame 13, so that said frame structure 16 may be moved bodily toward and away from the table top panel 45. To this end, the channel members 61, which form the opposite sides of the frame 13, may provide trackways for receiving and guiding rollers 67 on the opposite sides of a carrying frame 68, of preferably hollow sheet metal construction, extending between and guided for movement in the channel members 61.

The frame 68, at its upper end, carries a pair of channel members 69 which project in spaced, parallel, and facing relationship in position extending above the table top 45. These members 69 serve to receive and support the opposite side edges of the frame structure 16, the same preferably comprising serialographic apparatus of the sort shown in United States Letters Patent No. 2,552,858, which issued May 15, 1951, on the invention of R. J. Mueller and Ivan Burgeson. Such equipment embodies a fluorescent screen and a shiftable ray sensitive film cassette carriage, whereby either the fluorescent screen or a cassette carrying material sensitive to X-rays may be disposed in position above the table top for X-ray excitation by rays emanating from the ray source 14 beneath the table. As described in said United States Patent No. 2,552,858, the frame structure 16 may be adjusted in the guiding and supporting channels 69 to a projected position presenting the fluorescent screen in vertical alinement with an X-ray beam emanated from the source 14. The frame structure 16 may also be disposed in retracted or inactive position, within and between the members 69, in which position the frame 16 is withdrawn from above the table top to leave the same unobstructed above a body 15 supported thereon.

The weight of the frame 13 and of the carriage means 68 and the frame structure 16 thereon is counterbalanced substantially about the rotary axis of the ring 17 for all adjusted positions of the frames 13 and 68. To this end, a counterweight 70 of suitable mass is supported on a frame 71, which is provided with wheels or rollers 72 adapted to engage longitudinal tracks formed in the chordal member 37, whereby said counterweight is freely movable longitudinally of said chordal member. A pair of cables 73, each anchored at one end, as at 74, on the frame 13, is provided for interconnecting the frame with the counterweight, said cables being each anchored at their opposite ends, as at 75, on the counterweight carriage 71, the cables being guided around suitable pulleys 76 mounted on and at the opposite ends of the chordal member 37. The mass of the counterweight 70, of course, may be adjusted in accordance with the total weight of the frame 13 and the mechanism carried thereby to counterbalance said weight at all times about the axis of rotation of the ring-like frame 17.

In order to counterbalance the weight of the carriage frame 68 and the structure supported thereon about the turning axis of the ring-like frame 17, a counterweight 77 is provided for movement in and longitudinally of the chordal member 35, said counterweight being preferably provided with suitable roller means engaging in trackways formed on the chordal member. Cables 78 and 78' are provided for operatively connecting the counterweight 77 with the frame 68 in such fashion as to counterbalance the weight of said frame about the turning axis of the ring-like frame 17, regardless of the adjusted position of the frame 13 along the chordal members 33 and 37, and regardless of the adjustment of the frame 68 in the frame 13.

Accordingly, the cables 78 and 78', respectively, are connected, as at 79 and 79', to the opposite ends of the counterweight 77, and extend thence around guide pulleys 80 and 80' at the opposite ends of the chordal member 35. The cable 78, from its guide pulley 80, extends within and longitudinally of the chordal member 33, said cable, at the end thereof remote from the counterweight 77, being anchored, as at 81, on the chordal member 33 at or adjacent the end thereof remote from the chordal member 35. The anchored end of the cable 78 is thus connected with the ring-like frame 17. The cable 78', from its guide pulley 80', extends adjacent the chordal member 37, said cable, at the end thereof remote from the counterweight 77, being anchored, as at 81', on the bracket 38, at the end of the chordal member 37 remote from the chordal member 35. The cable 78' thus is also anchored on the ring-like frame 17.

Between the pulleys 80 and 80', the cables 78 and 78' are guided, respectively, on spaced pulleys 82 and 82' on and at the opposite ends of the frame 13. Between the pulleys 82, the cable 78 forms a loop 83 around a pulley 84 mounted on the frame 68, at one end thereof; and between the pulleys 82', the cable 78' forms a loop 83' around a pulley 84' mounted on the frame 68 in spaced relationship with respect to the pulley 84.

It will be seen from the foregoing that the cables 78 and 78', at the loops 83 and 83', are free to travel around the pulleys 82, 82', 84, and 84', in response to movement of the frame 13 along the chordal members 33 and 37, without altering the counterbalanced position of the weight 77 and the frame 68. The weight 77, however, counterbalances the weight of the frame 68 about the axis of rotation of the frame 17 in all positions of adjustment of the frame 68 in the frame 13. In that respect, movement of the frame 68 in the frame 13, in one direction or the other longitudinally of the frame members 61, results in shortening or lengthening the loop 83, and conversely in lengthening or shortening the loop 83'. As a consequence, the counterweight 77 will be adjusted on the chordal member 35 in accordance with the adjustment of the frame 68 in the frame 13, in order, at all times, to counterbalance the weight of the frame 68 about the turning axis of the ring frame 17.

The cassette and diaphragm carriage 47, which as previously mentioned is mounted within the table structure 11 for movement longitudinally thereof, is also counterbalanced against a weight 85 of suitable mass, said weight being movable on suitable roller trackways formed in the table frame structure 42, the opposite ends of the counterweight 85 being connected with the opposite ends of the carriage 47, as by means of cables 86 guided on pulleys 87 mounted in the table frame structure 42 at the opposite ends thereof.

In conjunction with the above described tiltable table structure, the present invention contemplates improved means for supporting an X-ray source 88 in position above the table structure, in order to direct X-rays through the table top 45 and onto cassette enclosed ray sensitive material mounted in the carriage 47 beneath or behind the table top, to thus provide for the making of radiographic pictures of a body supported on the table top. Since the table is adapted to be positioned at any desired inclination, it is desirable to provide for supporting the X-ray source 88 in any required position and at any required inclination within the adjustable range of the source supporting mechanism. Accordingly, the present invention contemplates apparatus 89 for supporting the ray source 88 for universal adjustment within the range of the support apparatus; and also support apparatus which may be adjustably moved rapidly and with minimum physical effort.

To these ends, the beam 22 for supporting the upper portions of the ring-like frame 17 provides roller trackways 90 and 91 extending longitudinally of the beam between the opposite ends thereof. The trackways 90 may comprise angle irons suitably fastened, as by welding, to and along the upper and lower edges of the beam structure 22. The trackway 91 may comprise a rib or flange suitably fastened, as by welding, to and along the

beam structure 22 medially between the trackways 90. The support structure 89 is carried on a frame, including a hollow, preferably formed sheet metal box portion 92, formed with rollers 93 in position to engage and ride in and along the trackways 90, and rollers 94 adapted to engage and ride along the opposite sides of the rib-like track 91. In addition to its portion 92, the support frame comprises a cantilever beam 95, of preferably formed sheet metal construction, said beam 95 being integrated, as by welding, at one end thereof, with the frame portion 92, corner bracing plates 96, which may be welded to the frame portions 92 and 95, being preferably employed to provide a rigid frame structure.

The beam 95 is formed with roller trackways 97, as at its opposite side edges, for the reception of rollers 98 mounted on a carriage 99, whereby the carriage is supported on the beam 95 for movement longitudinally thereof, the beam being preferably provided with an end stop 100 for limiting carriage movement thereon in a direction away from the frame portion 92. The beam 95 may also be provided on its under side with a medial longitudinal slot forming a trackway 101 for the reception of a roller 102 carried by the trackway.

Mounted on and dependent from the carriage 99 is a telescopically extensible framework 103 for supporting the X-ray source 88 on the carriage 99, said framework comprising a series of similar interfitting and relatively movable channel members 104, 105 and 106. The channel member 104, at one end, is integrally united, as by welding, with the carriage 99, the carriage 99 and dependent channel member 104 being braced and rigidified, as by means of corner bracing plates 107, which may be integrated, as by welding, to the opposite sides of the carriage and the dependent channel member 104. The dependent channel member 104 supports the next adjacent channel member 105, which in turn supports the channel 106. The channel 105 in turn supports a frame 108 upon which the X-ray source 88 is mounted.

The channel members 104, 105 and 106 each comprises elongated elements of formed sheet metal construction providing internal facing trackways 109 at and along the opposite edges of the members, the members 105 and 106 being each sized for sliding reception, respectively, on the members 104 and 105 within the spaced trackways thereof, the frame member 108 being formed for sliding reception on the member 106 between the trackways 109 thereof. The members 105, 106 and 108 are provided with rollers 110, at the opposite sides thereof, in position to rollingly engage each in the trackways of the next adjacent member. In addition, each of the members 105, 106 and 108 is provided with centrally disposed roller means 111 adapted, respectively, to ride in trackways 112 formed longitudinally and medially in the next adjacent member of the extensible frame structure 103. A spring pressed latch pin 113 may be provided on the member 108 in order to latch the same on the member 106, by engagement of the latch pin 113 in a perforation or socket formed in the member 106, in order to determine the limit of movement in one direction of the frame 108 on the channel member 106.

The frame 108 carries a dependent plate 114 having an opening 115, in which is journalled a yoke 116 having a central portion journalled on the plate 114, as by means of suitable, preferably roller bearings 117. The central portion of the yoke 116 is formed with a central opening 118 in alinement with the opening 115 in the plate 114. The yoke 116 also provides spaced end arms 119 forming bearings for turnably receiving the opposite ends of the support casing 120, in which an X-ray tube forming the X-ray source 88 may be mounted.

It will be seen from the foregoing that the X-ray source 88 may be moved to any desired position transversely of the table top 45, including positions substantially outwardly of the table top on one side thereof, when the table is in a position of maximum projection away from the plane of the ring-like frame 17, and on the other side thereof, when the table is in fully retracted position toward the plane of the ring-like frame 17, such transverse adjustment of the X-ray source with respect to the table top 45 being accomplished by longitudinal movement of the carriage means 99 on the beam 95.

It will be seen, also, that the X-ray source may be moved toward and away from the carriage 99, that is to say, away from and toward the table structure, within a wide range determined by the extensional and collapsible limits of the telescopic frame structure 103. In addition, the X-ray source may be tilted and adjusted in any desired angular position about the rotary axis of the yoke 116; and said source may also be adjusted tiltably to any desired angle about the turning axis defined by the yoke bearings 119, including a position in which the X-ray beam is directed through the alined openings 115 and 118. Such position is indicated in dotted lines in Fig. 2 of the drawings, wherein the ray source is disposed to direct an X-ray beam transversely through a body 15 on the table top in a direction away from the plane of the ring-like frame 17, such position allowing for the making of a radiographic picture on X-ray sensitive material, enclosed in a cassette and held or otherwise supported in the picturing position, as indicated in dotted lines at 121 in Fig. 2.

In order to make manipulation and adjustment of the X-ray source 88 exceedingly easy and effortless, on the part of the operator of the equipment, the mass of the adjustable parts is counterbalanced against a weight 123 which may be conveniently suspended on one end of a cable 124. The opposite end of the cable may be anchored, as at 125, on a suitable mounting at an end of the beam structure 22. From said mounting 125 the cable may extend around a guide pulley 126 on the frame 92, thence around a guide pulley 127 on the beam 95 at the end thereof remote from the support frame 92, the cable extending thence on a guide pulley 128 on the carriage 99, around a guide pulley 129 on the X-ray source supporting frame 108, around a guide pulley 128' on the carriage 99, adjacent the guide pulley 128, thence around a guide pulley 126' on the support frame 92, adjacent the guide pulley 126, and finally around a guide pulley 130 at the end of the beam 22 remote from the cable anchorage 125, the entire system being illustrated schematically in Fig. 10 of the drawings.

It will be seen that the foregoing system will allow the mass of the X-ray source to be counterbalanced against the weight 123 at all times during longitudinal movement of the frame 92 on the beam 22, the cable traveling freely around the rollers 126, 126', 127, 128, 128' and 129, during such longitudinal movement, and the counterbalance weight 123, as well as the pulley 130, remaining stationary. The structure also will remain counterbalanced for all adjusted positions of the carriage 99 longitudinally of the beam 95, the cable traveling freely on the pulleys 128, 128' and 129, the other pulleys 125, 126, 126', 127 and 130 remaining stationary, along with the counterweight 123, during longitudinal movement of the carriage 99 on the beam 95.

When the X-ray source 88 is adjusted vertically through the relative telescoping movement of the frame sections 104, 105 and 106 and the source supporting frame 108, the bite of the cable defined between the pulleys 128 and 128' by the pulley 129 will either lengthen or shorten as the X-ray source is lowered or raised. During such adjustment of the elevation of the X-ray source, the cable 124 may travel on the pulleys 126', 128', 129 and 130, the remaining pulleys 126, 127 and 128 remaining stationary, and the weight falling or rising as the source 88 is raised or lowered.

In addition, the weight of the frames 105 and 106 may be counterbalanced, as shown in Fig. 9 of the drawings, by connecting the frame 105 with a counterweight 105' operating in and longitudinally of the frame 104,

and by connecting the frame **106** with a counterweight **106'** operating in and longitudinally of the frame **105**, the frames **105** and **106** being respectively connected with their corresponding counterweights **105'** and **106'** by means of cables guided on pulleys **131**, respectively mounted on and at the upper ends of the members **104** and **105**.

In using the frame means **16** for the fluoroscopic examination of a body **15** on the table top, the operator may often wish to obtain a better view of a portion of the body presented in the viewing screen at or adjacent an edge thereof. Where the view is adjacent the side edges of the screen, as viewed by the operator standing alongside of the table structure **11**, the operator need merely shift the entire structure longitudinally of the table top in one direction or the other to dispose the viewing screen vertically above the body portion desired to be observed, thereby alining such body portion with the central portions of the screen. Where, however, the desired body portion to be viewed is at or adjacent either the inner or outer edge of the viewing screen, as seen by the operator standing in position alongside of the table structure, it is necessary to move the body **15** and its supporting table structure outwardly of the plane of the ring-like frame **17** in order to center, on the screen, a body portion presented in registration with the inner or upper edge of the viewing screen. Conversely, it is necessary to move the body and its supporting table structure inwardly toward the ring-like frame **17** in order to center, on the screen, a body portion presented in registration with the outer or lower edge of the screen.

The natural impulse of the screen viewer is to push the screen inwardly or pull the screen outwardly in a direction in order to adjust the same over the body portion; and the present invention takes advantage of this tendency to control the table shifting motor **57**, in order to adjust the body **15** beneath the viewing screen in directions transversely of the table structure. To this end, the frame structure **16** in its projected viewing position, shown in Figs. 2 and 14 of the drawings, is latched against longitudinal movement in the support channels **69** by means of a latch bar **132** on one of the members **69**. This latch bar may have a notch **133** in position to engage a turnable latch detent **134** on the structure **16**. The detent **134** may conveniently comprise the bent end of a rod **135**, turnably mounted in the frame **16** and extending at its opposite end to the outer end of the frame structure **16** and there connected with a spring pressed control button **136**, in position to be readily operated at the forward end of the frame structure **16**.

The spring normally urges the rod **135** in a direction to press the detent **134** into the notch **133**, to thereby lock the frame structure **16** in projected position. By pressing upon the button **136**, the detent **134**, against the influence of the spring, may be retracted from the notch **133**, whereupon the frame structure **16** may be pushed in the support channels **69** to a retracted position therein, the detent **134** riding along the edge of the bar **132**, and, if desired, engaging in a latching notch **133'** in order to secure the frame structure **16** in retracted position. The latch bar **132** may be mounted on the channel member **69** for limited movement longitudinally of the channel member, as by means of holding pins **137** in spaced position on the member **69** and extending in movement limiting slots **138** in the latch bar **132**. Spring means **139** may be provided for normally holding the latch bar **132** in a centered position.

A double-throw, center off switch **140** may be mounted on the member **69** in position with the operating handle **141** of the switch in engagement with a slotted flange **142** on the latch bar **132**, so that, when the detent **134** is latched in either of the notches **133** or **133'**, a push or a pull exerted on the frame structure **16** at the forward end thereof will cause longitudinal movement of the latch bar on the member **69**, against the influence of the spring means **139**, and will throw the switch **140** in one direction or the other. Upon release of the structure **16**, the spring means **139** will return the latch bar **132** to a neutral position, in which the switch **140** also is in its center off position. The switch **140**, of course, may be electrically interconnected to control the operation of the motor **57**, so that it will move the table structure outwardly of the ring-like frame **17** when the frame structure **16**, containing the viewing screen, is pushed inwardly toward the ring-like frame **17**, and vice versa.

It will be apparent, then, that when the operator of the equipment pushes inwardly on the frame structure **16**, the table will be moved outwardly and will carry the body under observation in such a direction that portions of the body under the inner portions of the viewing screen will be moved outwardly toward the center of the screen. Conversely, when the frame structure **16** is pulled, the table structure will move inwardly beneath the screen, and consequently move portions of the body **15** inwardly toward the center of the screen from beneath the outer edge portions thereof.

It will be seen, also, that the weight of the carriage **68** and of its counterbalance **77** is supported on the ring **17** and not upon the table frame **11**. The weight of the structure **13** and the mechanism carried thereby, together with the counterpoise weight **70**, are likewise carried by the ring structure **17** and not by the table frame **11**. In prior table tilting structures, adjustable components, corresponding with the frames **13** and **69** and their counterpoise weights, have been carried on the table structure itself and, consequently, have hence required additional counterpoise weight, in the table structure, to offset the out-of-balance condition resulting from adjustment of the table structure at various inclinations from horizontal, thus adding to the inertia of the total mass required to be moved in tilting the table. The counterpoise arrangements of the present invention, by applying the weight of the frames **13** and **69** and their cooperating counterpoise weights **70** and **77** directly upon the ring **17**, and counterbalancing the same about the axis of said ring, eliminates the necessity of providing additional counterpoise weight and allows reduction to a minimum of the inertia of the total weight required to be moved in turning the ring to tilt the table structure.

It is thought that the invention and its numerous attendant advantages will be fully understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the form herein disclosed being a preferred embodiment for the purpose of illustrating the invention.

The invention is hereby claimed as follows:

1. A table structure comprising a support frame embodying an annular track member, a chordal member extending between and secured to spaced anchorage stations on said track member, said chordal member extending substantially in the plane of said track member, beams secured in spaced relation on the track member at opposite ends of said chordal member in position extending substantially normal to and outwardly of the plane of said track member, means for supporting the track member for turning movement, in a substantially vertical plane, about the central axis of the track member, and a table frame supported on said beams for movement thereon in a direction toward and away from the plane of the track member.

2. A table structure comprising a support frame embodying an annular track member, chordal members in parallel, spaced relation and extending between and secured to spaced anchorage stations on said annular track

member, said chordal members extending substantially in the plane of said track member, beams secured in spaced relation on the track member at opposite ends of said chordal member in position extending substantially normal to and outwardly of the plane of said track member, means for supporting the track member for turning movement, in a substantially vertical plane, about the central axis of the track member, an elongated table frame supported on said beams for movement thereon in a direction intersecting the plane of the track member, a ray equipment carriage means supported on said chordal members for adjusting movement in the longitudinal direction of said table frame.

3. A table structure comprising a support frame, an elongated table frame mounted on the support frame, a carriage movable on the support frame in the longitudinal direction of the table frame, ray equipment supported on the carriage, in position extending in the vertical zone of the table frame, and adjustable with said carriage longitudinally of the table frame, said table frame being adjustable on the support frame transversely of the table frame, to thereby transversely adjust said ray equipment with respect to the table frame, and means operable in response to pressure exerted on said carriage supported ray equipment, in one direction or the other, transversely of said table frame, to adjustably move the table frame in the opposite direction.

4. A table structure comprising a support frame, an elongated table frame mounted on the support frame, a carriage movable on the support frame in the longitudinal direction of the table frame, ray equipment supported on the carriage, in position extending in the vertical zone of the table frame, and adjustable with said carriage longitudinally of the table frame, said table frame being adjustable on the support frame transversely of the table frame, to thereby transversely adjust said ray equipment with respect to the table frame, including power operated means for adjusting the table frame, transversely thereof, in either direction, on the support frame, and control means for said power operated means operable in response to pressure exerted on said carriage supported ray equipment, in one direction or the other, transversely of said table frame, to cause adjusting movement of the table frame in the opposite direction.

5. A table structure comprising a support frame embodying an annular track member, means for supporting the track member for turning movement in a substantially vertical plane, comprising carrying rollers for supporting the lower portions of said track member for rolling movement thereon, an elongated beam member extending substantially in the plane of said track member and affording means for supporting the opposite sides of said track member, at the top thereof, to hold the same upright upon said carrying rollers, a table frame carried on said support frame on one side of the plane of said track member, means for supporting a ray source on said beam member in position for adjustment relative to said table, comprising a carrier frame supported for movement on and longitudinally of said beam member, a cantilever beam mounted on said carrier frame in position extending outwardly of said beam member, a carriage supported on and movable longitudinally of said cantilever beam, toward and away from said beam member, a series of telescopically interfitting frames each mounted on and adjustable longitudinally of the next adjacent frame of the series, one of said frames comprising a supported end frame of the series being secured on said carriage in position depending therefrom, and mounting means for mounting the ray source on another of said frames comprising a supporting end frame of the series.

6. A table structure comprising support means embodying a ring-like track member and a carrying means mounted on said track member, bearing means operatively associated with said track member for mounting the carrying means for turning movement in the plane of said track member about the central axis thereof, said carrying means comprising spaced arms, extending in a direction intersecting the plane of said track member, and a chordal beam secured at its opposite ends of said track member adjacent said arms, an elongated table frame, means for mounting the table frame on said arms for adjusting movement thereon in a direction intersecting the plane of the track member, carriage means movable on said beam in the direction of the plane of said track member, and means for supporting a ray source and ray sensitive material on said carriage means on opposite sides of said table frame.

7. A table structure comprising a support frame embodying an annular track member, a chordal member extending between and secured to spaced anchorage stations on said track member, said chordal member extending substantially in the plane of said track member on one side of its central axis, beams secured in spaced relation on said support frame adjacent said anchorage stations in position extending outwardly of the plane of said track member, means for supporting the track member for turning movement, in a substantially vertical plane, about the central axis of the track member, an elongated table frame supported on said beams for movement thereon in a direction transversely of said table frame toward and away from the plane of said track member, and ray equipment carriage means mounted on said chordal member for adjusting movement longitudinally of said table frame.

8. A table structure comprising a support frame embodying an annular track member, means for supporting the track member for turning movement in a substantially vertical plane, comprising carrying rollers for supporting the lower portions of said track member for rolling movement thereon, an elongated beam member extending substantially in the plane of said track member and affording means for supporting the opposite sides of said track member, at the top thereof, to hold the same upright upon said carrying rollers, a table frame carried on said support frame on one side of the plane of said track member, and means for supporting a ray source on said beam in position for adjustment relative to said table, comprising a carrier frame supported for movement on and longitudinally of said beam member, telescopically interfitting frames including a suspension frame supported on said carrier frame and a suspending frame supported from the suspension frame, and carrying means for mounting a ray source thereon.

9. A table structure comprising a support frame forming a circular track member, means for supporting the track member for turning movement in a substantially vertical plane, comprising carrying rollers for supporting the lower portions of said track member for rolling movement thereon, an elongated beam member extending substantially in the plane of said track member and affording means for supporting the opposite sides of said track member, at the top thereof, to hold the same upright upon said carrying rollers, a table frame carried on said support frame on one side of the plane of said track member, and a support structure mounted on said beam member for carrying a ray source in adjustable position relative to said table, said structure comprising a carrier frame supported for movement on and longitudinally of said beam member, a cantilever beam and means to supportingly connect one end thereof on said carrier frame, and ray source carrying means mounted on said cantilever beam for adjustable movement longitudinally thereof.

10. A table structure comprising a support frame forming a circular track member, means for supporting the track member for turning movement in a substantially vertical plane, comprising carrying rollers for supporting the lower portions of said track member for rolling

movement thereon, an elongated beam member extending substantially in the plane of said track member and affording means for supporting the opposite sides of said track member, at the top thereof, to hold the same upright upon said carrying rollers, a table frame carried on said support frame on one side of the plane of said track member, and a support structure mounted on said beam member for carrying a ray source in adjustable position relative to said table, said structure comprising a carrier frame supported for movement on and longitudinally of said beam member, a centilever beam and means to supportingly connect one end thereof on said carrier frame, ray source carrying means mounted on said cantilever beam for adjustable movement longitudinally thereof, and telescopically interfitting frames, including a suspension frame supported on said carrier frame and a suspending frame supported on the suspension frame and supportingly connected with said ray source carrying means.

11. A table structure comprising support means embodying a ring-like track member and table carrying means supported on said track member, bearing means operatively associated with said track member for mounting the table carrying means for turning movement in the plane of said track member about the central axis thereof, said table carrying means comprising spaced arms extending in a direction intersecting the plane of said track member, a table frame, and means for mounting the table frame on said arms for adjusting movement thereon in a direction intersecting the plane of said track member.

12. A table structure as set forth in claim 11, including means forming a track paralleling said table frame, a ray source, carrier frame means for supporting ray sensitive material, and carriage means movable on said track longitudinally of said table frame and supporting said ray source and said carrier frame on opposite sides of said table frame.

13. A table structure as set forth in claim 11, including means forming a track paralleling said table frame, a ray source, carrier frame means for supporting ray sensitive material, and carriage means movable on said track longitudinally of said table frame and supporting said ray source and said carrier frame on opposite sides of said table frame, said carrier frame being shiftably supported on said carriage means for adjusting movement thereon, toward and away from the table frame.

14. A table structure as set forth in claim 11, including means forming a track paralleling said table frame, a ray source, carrier frame means for supporting ray sensitive material, and carriage means movable on said track longitudinally of said table frame and supporting said ray source and said carrier frame on opposite sides of said table frame, said carrier frame being shiftably supported on said carriage means for adjusting movement thereon, toward and away from the table frame, and counterbalancing means mounted on said table carrying means and drivingly connected with said carrier frame and carriage means for counterbalancing the movable mass thereof in all relatively adjusted positions with respect to said support means.

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