Dec. 10, 1940. W. H. HAUPT 2,224,262

X-RAY REVERSIBLE TILT TABLE

Filed Feb. 21, 1940 3 Sheets-Sheet 1

Fig. 1

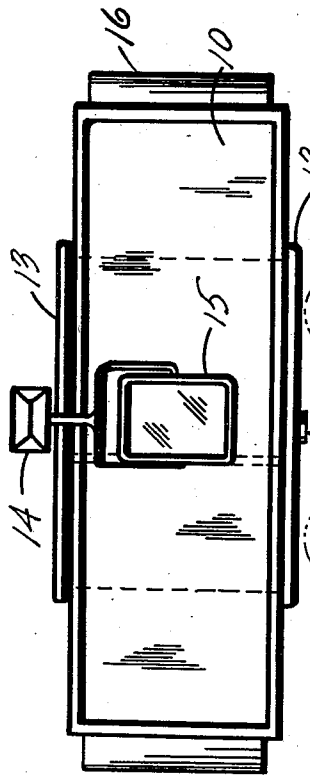


Fig. 2

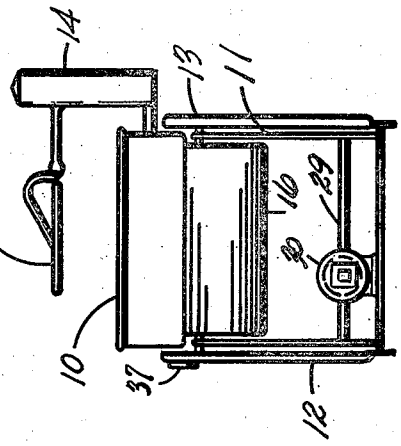


Fig. 3.

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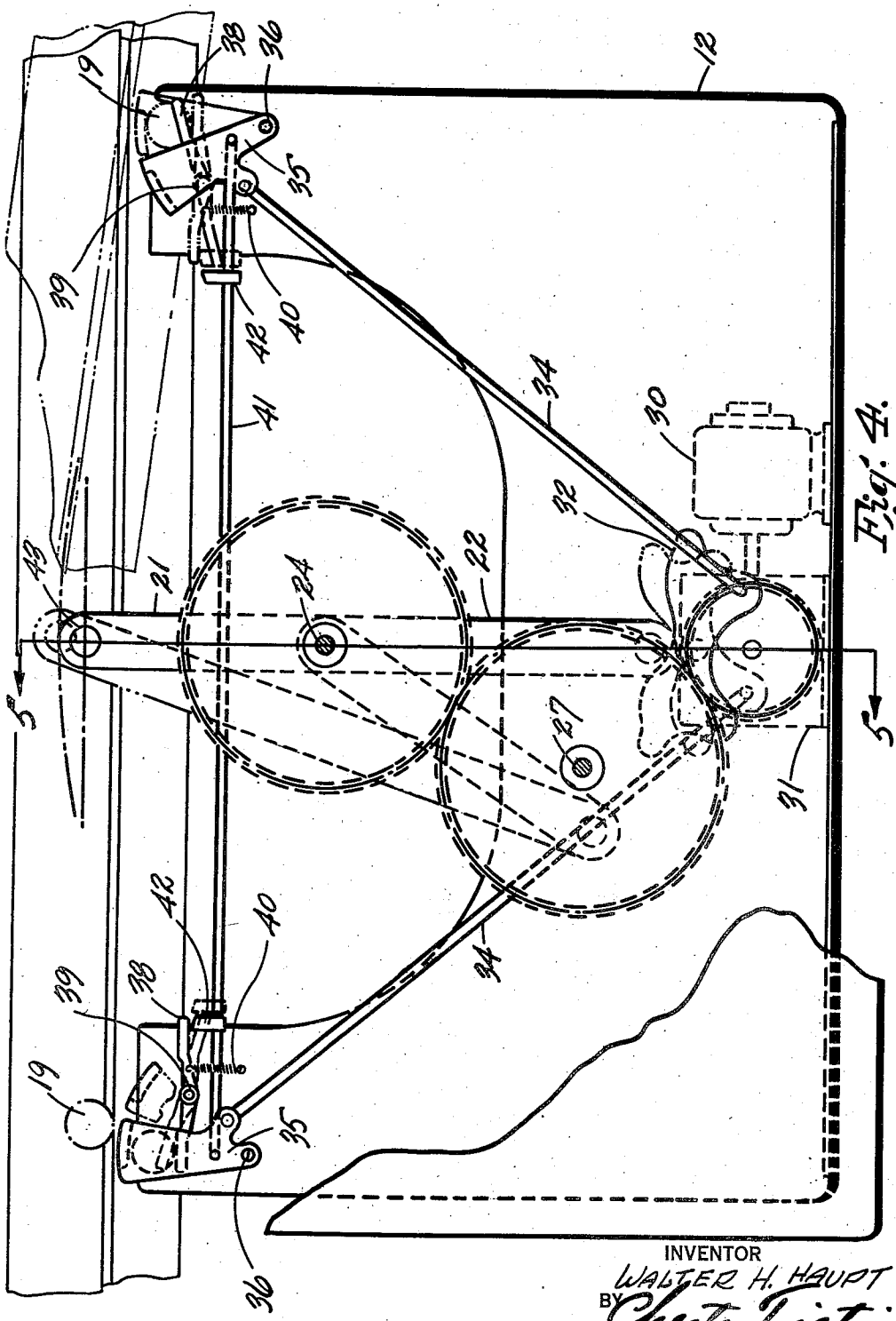


Fig. 4.

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X-RAY REVERSIBLE TILT TABLE

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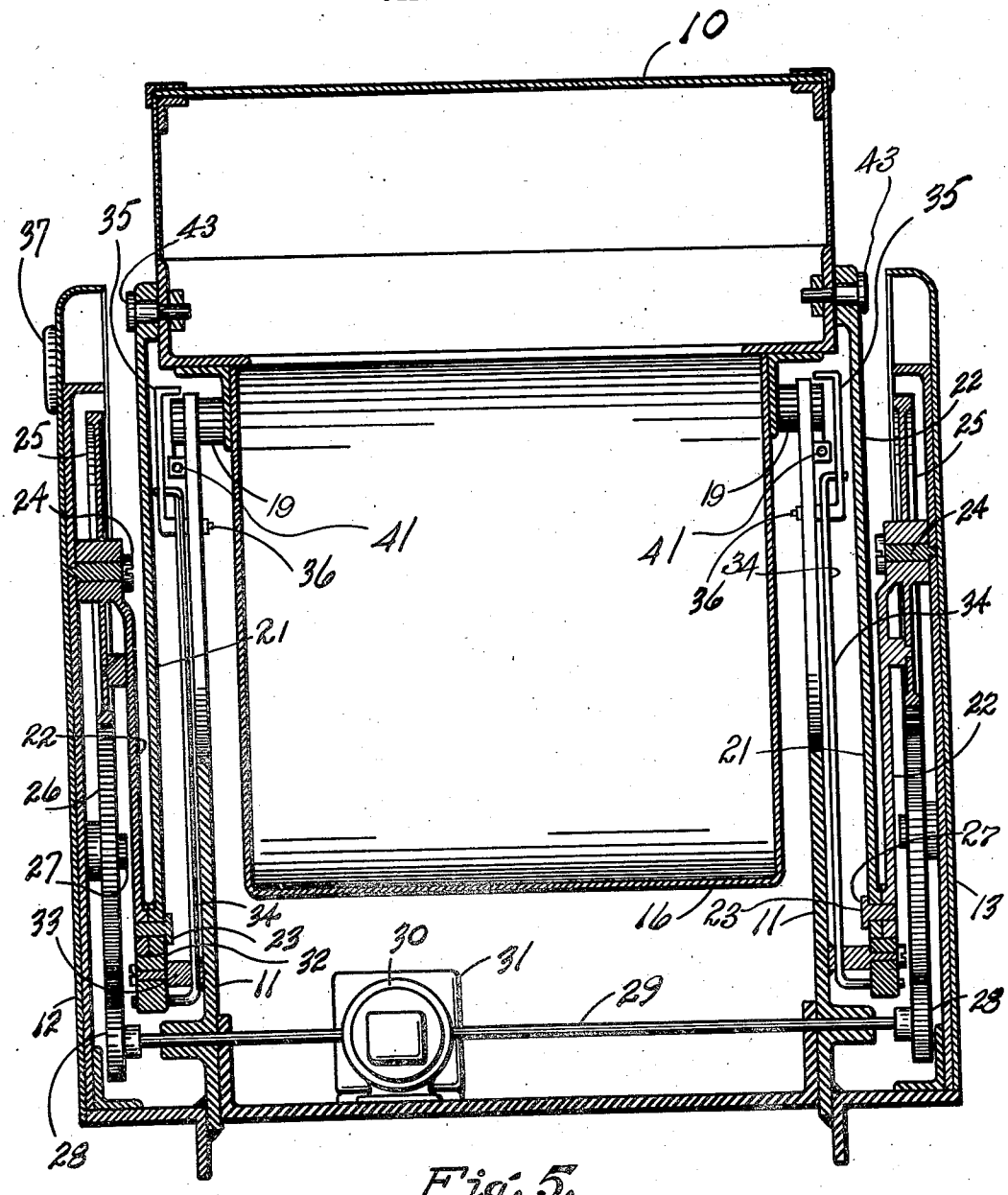


Fig. 5.

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UNITED STATES PATENT OFFICE

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X-RAY REVERSIBLE TILT TABLE

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Application February 21, 1940, Serial No. 320,161

13 Claims. (Cl. 311—38)

This invention relates to a reversible X-ray tilt table. By "reversible" is meant that the table is tiltable to an erect position and all positions intermediate of horizontal and erect at either end.

This application is a continuation-in-part of my co-pending case Serial No. 262,002, now Patent No. 2,222,888, dated Nov. 26, 1940, filed March 15, 1939.

Among the objects of the invention are to provide a table of the construction described, the operation of which is to a larger degree governed by purely mechanical elements than has hitherto been invented. In particular, the locking mechanism of the table of the present invention is entirely mechanical and hence does not rely upon solenoids. By the elimination of solenoids, I have provided a construction which is simpler, less likely to become deranged and which may be more easily repaired by inexpert labor.

In the accompanying drawings,

Fig. 1 is a plan view of the table.

Fig. 2 is an end view.

Fig. 3 is a side elevation, the elevated position of the table being shown in dotted line.

Fig. 4 is a side elevation of the table base and a part of the table bed, showing the locking and elevating mechanism in detail.

Fig. 5 is a full view taken in cross section on the line 5—5 of Fig. 4.

In the drawings, 10 is a table bed of boxlike dimensions in appearance very similar to conventional table beds now in use on X-ray tilt tables. Supporting the table 10 is a frame 11. Said frame is provided with a front apron 12 and a rear apron 13 which serves the dual purpose of concealing the mechanism and of supporting a considerable proportion of it. Supported by the table bed 10 is a standard 14 to which is pivotably attached a fluorescent screen 15. Said standard and screen are traversable over the table bed in the conventional manner, regardless of whether the position of the latter is horizontal or vertical. 16 is a corona shield or static shield for the X-ray tube (not shown) which traverses the table beneath the table bed 10. A Bucky diaphragm 17 may also be adapted to traverse the table in the slot 18 in the conventional manner.

The mchanism which is the subject matter of this application, is substantially dual, that is, that there are two sets of it, one on either side of the frame 11, which two sets are duplicates. Likewise, the duplication also extends to the table top, which is provided with two sets of pivots 19 which are locked upon the sides of the table and are adapted to fit into sockets 20, of which there are also four, these sockets being locked near the ends of the aprons 12 and 13. The pivots cooperate with the sockets in order to provide an axis about which the table bed may be rotated. The rotating or lifting means comprises a link 21 of which there is one on each side of the table and attached to a pivot 43 at the middle point of the table bed. A second but shorter link 22 is pivoted to link 21 by means of pivot 23. The other end of link 21 is rigidly located by means of a screw 24 to a large spur gear 25 which is rotatably mounted on the aprons. This gear is duplicated at the other side of the table in a corresponding position. Gear 25 is arranged to mesh with an intermediate gear 26 also rotatably mounted on the aprons, the hub of which gear is about on the level with the lowermost arc of travel of pivot 23. Link 22 is made in two planes so that it may conveniently clear the pivot 27 of gear 26. A driving pinion 28 drives gear 26 with power derived through a shaft 29 which is disposed crosswise of table frame 11. The shaft 29 is driven by an electric motor 30 through an enclosed worm gear drive 31.

What has been described so far has also been described in my co-pending application Serial No. 262,002, so that the foregoing matter may here be regarded as conventional in the prior art for the purpose of more clearly emphasizing the novelty which follows.

The means provided for locking and unlocking the pivots 19 into their respective sockets 20 is purely mechanical. A cam 32 of a general butterfly shape is mounted upon each of the aprons 12 and 13 by means of a pivot 33, said pivot and cam being preferably located on the crosswise middle line of the table at a point where the cam will be contacted by the arc described by the sweep of links 21 and 22. Such cam actuation is, of course, intended to occur simultaneously and in synchronism on both sides of the table.

Connected to the lower lobes of the butterfly shaped cam 32 there are rods 34 extending to and connected with latches 35 which are pivoted to the aprons 36 and are swingable over pivots 19 when they rest in sockets 20. The rods are so connected that oscillation of the cam 32 under the urging of the lower ends of links 21 and 22 will open that latch 35 which is on the side of the cam which is depressed. The selection of which side of the cam is to be depressed and consequently which side of the table is to be

lifted is governed by the direction of rotation of motor 30. This in turn is governed by the manual actuation of a double pole, double throw switch 37 and its associated electrical circuit, which, being a conventional motor reversing circuit, is not shown in detail.

In order to prevent accidental shifting of the latches 35 and possible slipping of the pivots 19 from their sockets, there is provided a latch blocking mechanism which is effective whenever one pair of pivots is out of their proper sockets. The mechanism comprises a blocking lever at each socket extending over said socket as to its one end. Each lever 38 is pivoted at its middle point by a pin 39. The end of the lever 38 which is furthest from the socket is held down by a spring which is fast to the respective apron.

Cooperating with latches 35 there is a bar 41 connecting them. The bar is of such a length that one of the latches 35 must be closed when the other is open. Cooperating with the inner ends of levers 38 are stops 42, rigidly fastened to bar 41. When the lever end abuts the stop 42, no motion of the bar 41 is possible to the extent of unlocking any pivot. However, when one end of the table bed is descending, the pivots 19 depress the outer ends of levers 38, thereby lifting their other ends and freeing bar 41 for horizontal motion.

It is to be understood that there are four levers 38 and two bars 41 on each apparatus, i. e., that the two sides of the apparatus are duplicates.

In a table of this type which is tilted or raised by applying a lifting force at the center, the natural tendency would be for the light end to lift while the heavy end remains weighted in the socket of the support pivots. Therefore, it becomes essential that substantial and satisfactory locks be provided for the pivots about which the table should rotate. It will also be obvious that if there is any lost motion or looseness between the locking member and the pivot that the lighter end of the table would first lift until forced to remain in a position by the lock and then it would force the pivot into its socket again. This would result in a jerky and uneven motion. Therefore, it is very important that the latches 35 fit closely over the pivots 19 allowing a minimum of lost motion.

From a theoretical consideration therefore, when the lifting links 21 and 22 approach center, the elevated pivots will be approaching their sockets and at the moment that the lifting links pass center all pivots will be fitted into their sockets. The moment, however, that the lifting link passes its center position there will be a tendency to lift the table at one end or the other out of the pivot sockets.

In the embodiment of such an arrangement it is found that the actual lifting of the table will not be immediate when the lifting links pass the center of their travel. This is due to two factors, first the arc in which these links travel is of a rather large radius and the bottom of the arc is very flat thus giving a very slight vertical displacement during the lower five or ten degrees of the travel. Second: the table top structure which is being tilted, has a rather substantial weight and before any actual lifting takes place there is a slight deflection of the table bed portion connecting the center attachment pivot 43 of the lifting link with the pivots 19. This deflection though very small, is sufficient to allow a few degrees of travel of the lifting link 21 on either side of center before either one of the pivots 19 is raised out of its socket. It is this travel of the lifting links which is being utilized in this invention, in order to provide a mechanical motion of sufficient amplitude to shift the pivot latches at the proper times and in the desired direction while both pivots are in their sockets. In order to do this, a cam actuated by the lower end of the lifting link has been provided and this cam 32 is so connected to the latches 35 as to provide the necessary motion when the table is horizontal and to determine which pivot shall be raised according to the direction of travel of the lifting links.

If there were no flexing of the connected member between the center lifting pivot 43 and the pivots 19 in the table top structure it would be theoretically conceivable that the moment the lifting link has passed center there would be a resultant vertical movement due to the slight upward curvature of the arc. This movement would immediately lift one or the other of the pivots from its socket against the latches and thus prevent or make difficult the shifting of the locks as stated above. If the end to be lifted happened to be the heavy one the light end would be lifted against the lock and possibly released with a jerk under the strain of the necessary applied forces.

The operation of the table presents no difficulties to any operator. The only things that must be determined by him are: (1) to choose which end of the table he wishes to elevate (2) to choose how far he wishes the elevation to go. He selects (1) by operating switch 37 to one side or other according to which direction he wishes the motor 30 to run. When the table has been lifted sufficiently he merely releases the switch 37, which is of the momentary contact type and motion ceases. If he should forget to release the switch the table cannot go beyond the vertical because the link length is then at a maximum. Limit switches (not shown) are, however, normally provided to stop the motor before the links go over center.

I claim as my invention:

1. In an X-ray tilt table of the type in which mechanism is provided to tilt the table bed to either left or right, a frame, a table top tiltable on said frame, a reversible electric motor mounted on said frame, a drive from said motor to said table and a compound cam engageable by a part of said drive after a small preliminary movement thereof in either direction to left or right of center, mechanical locking means for the ends of said table, and means connecting said cam with locking means at both ends of said table, said connection means and locking means being actuable under the urging of said cam to lock one end of said table pivotably to said frame at that end of said table opposite the end that it is desired to raise.

2. In an X-ray tilt table of the type in which mechanism is provided to tilt the table bed to either left or right, a pair of compound tilting links, one of said links movable as to its lower end in an arc, a compound cam engageable by said link end after a small amount of travel of said end to left or right of center, and mechanical locking means for the ends of said table actuable under the urging of said cam to lock one end of said table to a fixed pivot, the said locking action taking place at that end of said table opposite to the direction of movement made by said link end.

3. In a substantially rectangular X-ray tilt table of the type having a pivot near each corner of said table and socket therefor which pivots permit the table to be selectively tilted toward either end, a pair of compound links adapted to raise said table, a drive for said links including a reversible electric motor and a crank driven thereby, slidable locks over each of said pivot sockets, said locks being mechanically actuable in pairs at either end of said table and cam actuated locking and unlocking means for said pivot locks, said means being selectively operable as to whether a locking or unlocking action at a given end of said table is desired by controlling the direction of rotation of said electric motor.

4. In a substantially rectangular X-ray tilt table of the type having a pivot near each corner of said table which pivots permit the table to be selectively tilted toward either end and sockets therefor, a pair of compound links adapted to raise said table, a drive for said links including an electric motor and a crank driven thereby, said crank being connected to one of said links, locks over said pivot sockets, said locks being mechanically actuable in pairs at either end of said table, a locking and unlocking means for said locks, said means comprising a cam, said cam being actuable by contact with one of said links during a period of travel near dead center of said link to transmit locking motion to one pair of said pivot locks and unlocking motion to the other pair simultaneously.

5. In a substantially rectangular X-ray tilt table of the type having a pivot near each corner of said table which pivots permit the table to be selectively tilted toward either end and sockets therefor, a pair of compound links adapted to raise said table, a drive for said links including an electric motor and a crank driven thereby, said crank being connected to one of said links, locks over said pivot sockets, said locks being mechanically actuable in pairs at either end of said table, a locking and unlocking means for said locks, said means comprising a double cam intermediate of the ends of said table and in contact with at least one of said links and actuable thereby, a rod extending from each side of said cam to one of said pivot locks and transmitting motion from said cam to lock or unlock, selectively, said lock.

6. In a substantially rectangular X-ray tilt table of the type having a pivot near each corner of said table which pivots permit the table top to be selectively tilted toward either end and sockets therefor, a pair of compound links adapted to raise said table, a drive for said links including a reversible electric motor and a crank driven thereby, said crank being connected to one of said links, locks comprising latches over said pivot sockets, said locks being mechanically actuable in pairs at either end of said table, a locking and unlocking means for said locks, said means comprising a double cam intermediate of the ends of said table and in contact with at least one of said links and actuable thereby, a rod extending from each side of said cam to one of said pivot locks and transmitting motion from said cam to lock or unlock, selectively, said lock, and a rod connecting the latches of the locks upon each side of said table to insure the operation of said latches in unison.

7. In a substantially rectangular X-ray tilt table of the type having a pivot near each corner of said table which pivots permit the table to be selectively tilted toward either end and sockets therefor, a pair of compound links adapted to raise said table, by each end of said table top, a drive for said links including a reversible electric motor and a crank driven thereby, said crank being connected to one of said links, locks comprising latches over said pivot sockets, said locks being mechanically actuable in pairs at either end of said table, a locking and unlocking means for said locks, said means comprising a double cam intermediate of the ends of said table and in contact with at least one of said links and actuable thereby, a rod extending from each side of said cam to one of said pivot locks and transmitting motion from said cam to lock or unlock, selectively, said lock, and a control for said electric motor including a switch capable of reversing the direction of rotation of said motion.

8. In a substantially rectangular X-ray tilt table, a table bed, a pivot extending outwardly near each of the corners of said table bed, a frame supporting and partially inclosing said table bed, an apron supported by said frame, a plurality of gears rotatably attached to the inner side of said apron, and adapted to tilt said table bed, an electric motor mounted on said frame and adapted to drive said gears, a pair of compound links connected between said table bed and one of said gears mounted upon said apron, pivot sockets near each corner of said frame adapted to accommodate said pivots, locks comprising latches over said pivot sockets, said locks being actuable in pairs at either end of said table, a locking and unlocking means for said locks, said means comprising a double cam intermediate of the ends of said table and mounted below one of said gears and adapted to make contact with and be actuated by one of said links, a rod extending from each side of said cam to one of said pivot locks and supporting said cam, each rod being adapted to transmit motion from said cam to one of the latches of said lock whereby said lock will lock or unlock said pivot, and a rod connecting the latches of the locks upon each side of said table.

9. In a substantially rectangular X-ray tilt table, a table bed, a pivot extending outwardly near each of the corners of said table bed, a frame supporting and partially inclosing said table bed, aprons supported by said frame on each side of said table bed, a plurality of gears rotatably attached to the inner side of each of said aprons and adapted to tilt said table bed by lifting each side thereof, a reversible electric motor mounted on said frame and adapted to drive said plurality of gears, a pair of compound links connected between said table bed and one of said gears mounted upon each of said aprons, pivot sockets near each corner of said frame adapted to accommodate said pivots, locks comprising latches actuable over said pivot sockets, said locks being actuable in pairs at either end of said table, a double locking and unlocking means for said locks, said means comprising two double cams intermediate of the ends of said table, one of same being mounted below one of said gears on each apron and adapted to make contact with and be actuated by one of said links, a rod extending from each side of each of said cams to one of said pivot locks and supporting said cams, each rod being adapted to transmit motion from its cam to one of the latches of said lock whereby said lock will lock or unlock said pivot, a rod connecting the latches of the locks upon each side of said table and a control for said motor capable of determining the direction of rotation thereof.

10. In a substantially rectangular X-ray tilt table, a frame, a table bed supported by said

frame, at least four sockets near the corners of said frame for the reception of pivots, at least four pivots near the corners of said table bed and projecting therefrom and adapted to fit said sockets, compound link means on either side of said table bed and capable of exerting a lifting force on the middle thereof, an apron supported by said frame on each side of said table bed, a train of gears on each apron and supported thereby, said gear trains each driving compound link, a common electric motor driving both gear trains, a symmetrical double cam for each side of said table adapted to be engaged by the lower end of said link means, latches engageable with said pivots when the latter are in said sockets, and rod means connecting said cam and latches whereby to unlock the latches at one end of said table while locking the latches at the other to determine which end of said table bed may be tilted.

11. In a substantially rectangular X-ray tilt table, a frame, a table bed supported by said frame, at least four sockets near the corners of said frame for the reception of pivots, at least four pivots near the corners of said table bed and projecting therefrom and adapted to fit said sockets, compound links on either side of said table bed and capable of exerting a lifting force on the middle thereof, an apron supported by said frame on each side of said table bed, a train of gears on each apron and supported thereby, said gear trains each driving compound links, a common electric motor driving both gear trains, said motor, said gear trains and said links together constituting a table bed raising means, a symmetrical double cam for each side of said table adapted to be engaged by a member of said table raising means, latches engageable with said pivots when the latter are in said sockets, and rod means connecting said cam and latches whereby to unlock the latches at one end of said table while locking the latches at the other to determine which end of said table bed may be tilted.

12. In an X-ray tilt table of the type in which mechanism is provided to tilt the table bed to either left or right, a frame, a table top tiltable on said frame, a reversible electric motor mounted on said frame, a drive from said motor to said table top and a compound cam engageable by a part of said drive after a small preliminary movement thereof in either direction to left or right of center, mechanical locking means for the ends of said table, means connecting said cam with locking means at both ends of said table, said connecting means and locking means being actuable under the urging of said cam to lock one end of said table pivotably to said frame at that end of said table opposite the end that it is desired to raise and means for preventing actuation of said locking means unless said table bed is in its lowermost position.

13. Apparatus of the kind claimed in claim 12 in which the means for preventing actuation of the locking means unless the table is in its lowermost position comprises at least one lever pivotally mounted adjacent the mechanical locking means for the ends of said table, and said locking means includes an actuating bar, stop means on said bar, a spring urging that end of said lever into engagement with said locking means, a pivot supporting said lever at a point substantially at which the opposite end of said lever will be angled upward when the first end engages said stop means, said angled end being then engageable by the table top at the time of descent of said top near horizontal to disengage the opposite end of said lever from the stop means on said actuating bar to free the latter for operation.

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