

United States Patent

[11] 3,588,500

[72]	Inventor	Harry E. Koerner Catonsville, Md.
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[73]	Assignee	Westinghouse Electric Corporation Pittsburg, Pa.

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Primary Examiner—William F. Lindquist

Attorneys—F. H. Henson, E. P. Klipfel and D. F. Straitiff

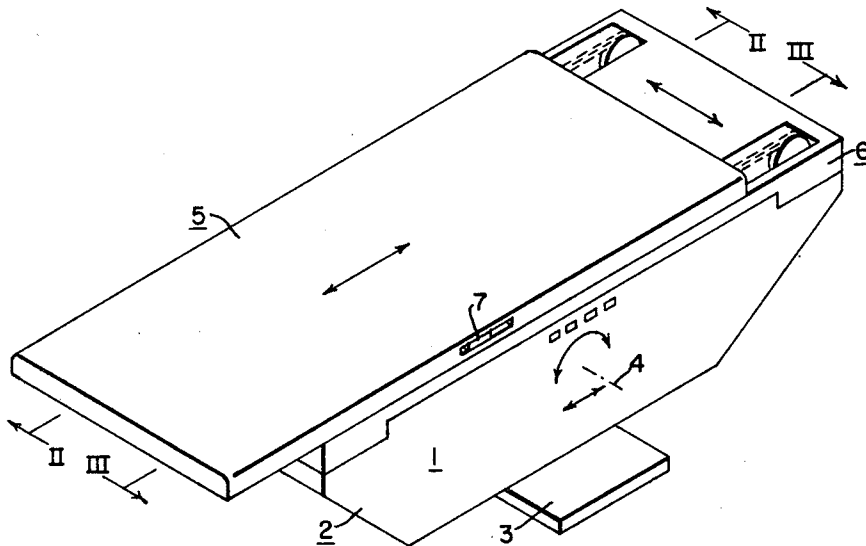
[54] X-RAY TABLE WITH SELECTIVE FLOAT AND POWER DRIVE TOP
7 Claims, 18 Drawing Figs.

[52]	U.S. Cl.....	250/55, 250/54
[51]	Int. Cl.....	G01n 23/04
[50]	Field of Search.....	250/55, 54, 56, 57, 8, 9

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ABSTRACT: Described is a motorized tilttable X-ray table with a longitudinally movable floating top on a floating cross-carriage frame which is engageable with power drive chain means in the frame via a lever-operated mechanism in the top. The top is coupled longitudinally to a multiturn cable drum in the frame via a cable loop. A brake on the drum provides longitudinal float position locking of the top. Control means for the table prevents tilting of the table while the top is floating longitudinally, and, in tilted table attitudes, prevents disengagement of the top from the drive chain means, permits longitudinal powerdrive of the table top and transverse floating movement of the cross-carriage frame.



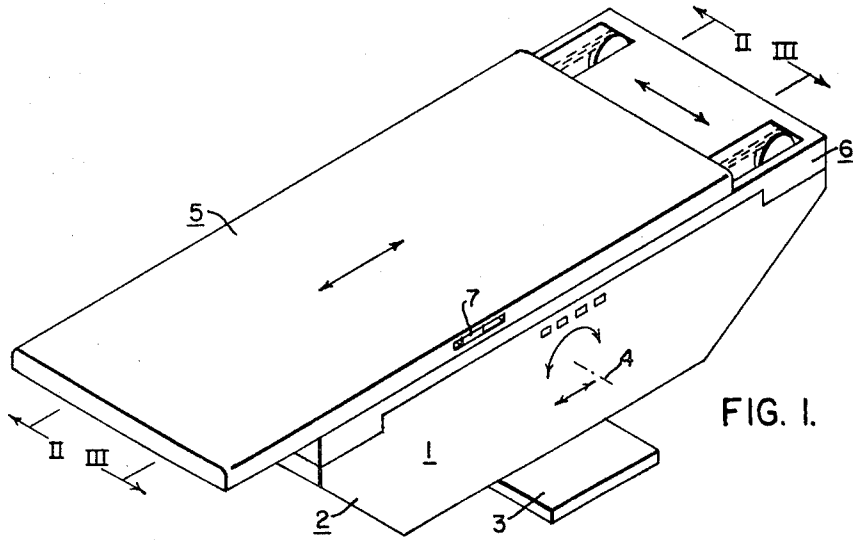


FIG. 1.

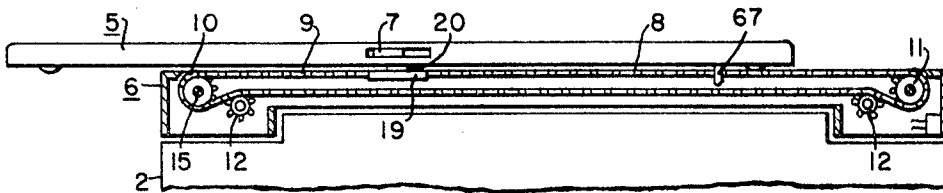


FIG. 2.

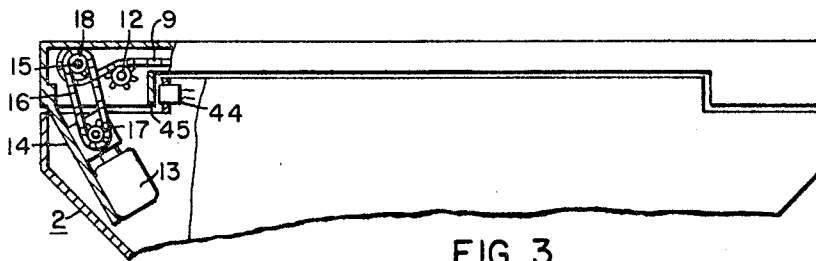


FIG. 3.

WITNESSES:

Leon M. Garman
James F. Young

INVENTOR

Harry E. Koerner

BY

D.F. Strautiff
AGENT

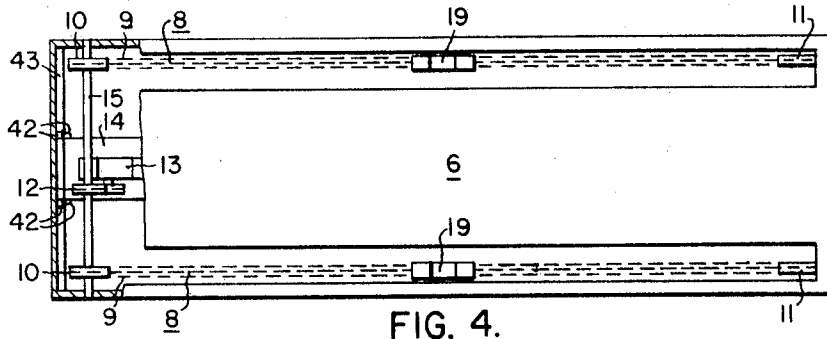


FIG. 4.

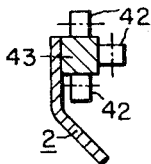


FIG. 5.

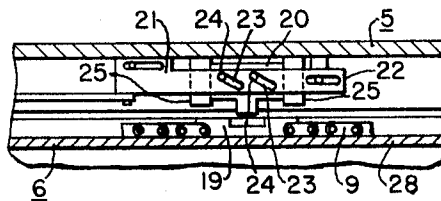


FIG. 6.

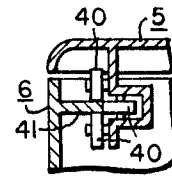


FIG. 7.

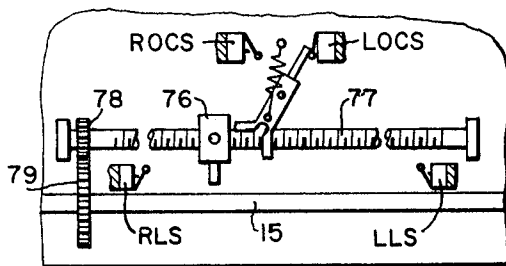


FIG. 9.

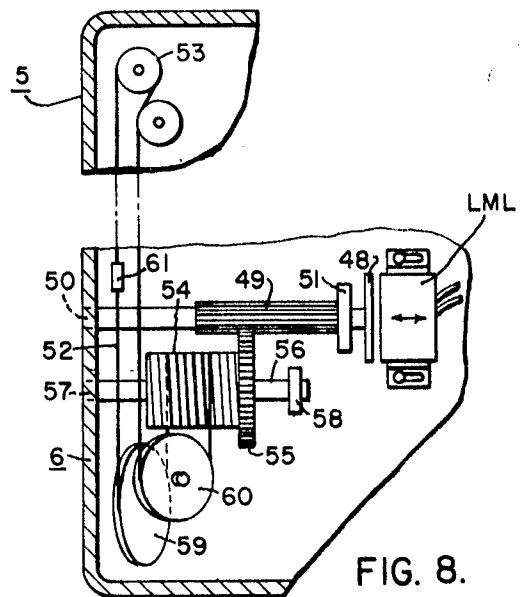


FIG. 8.

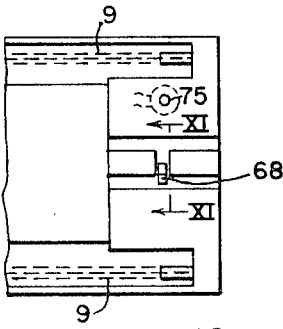


FIG. 10.

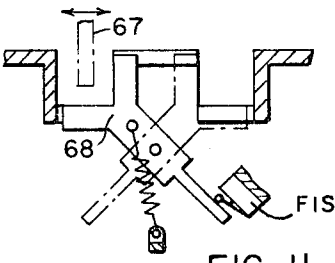


FIG. 11.

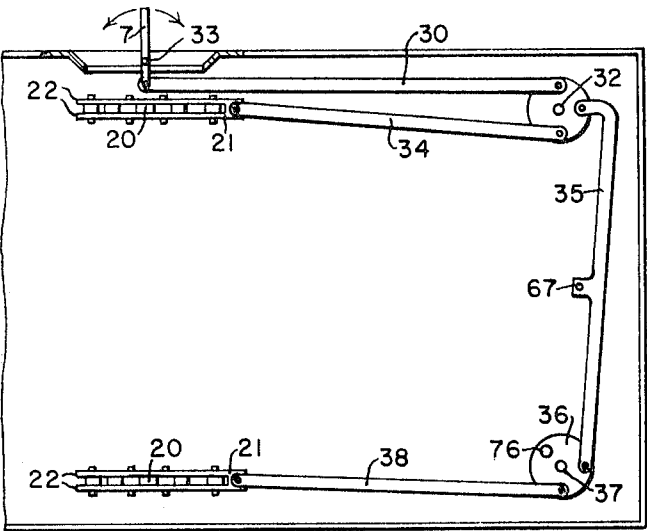


FIG. 12.

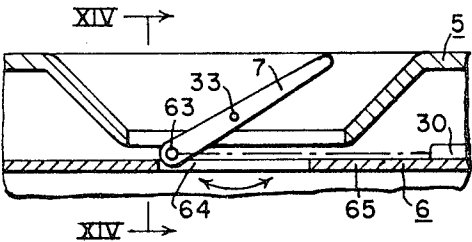


FIG. 13.

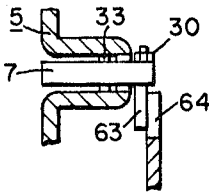


FIG. 14.

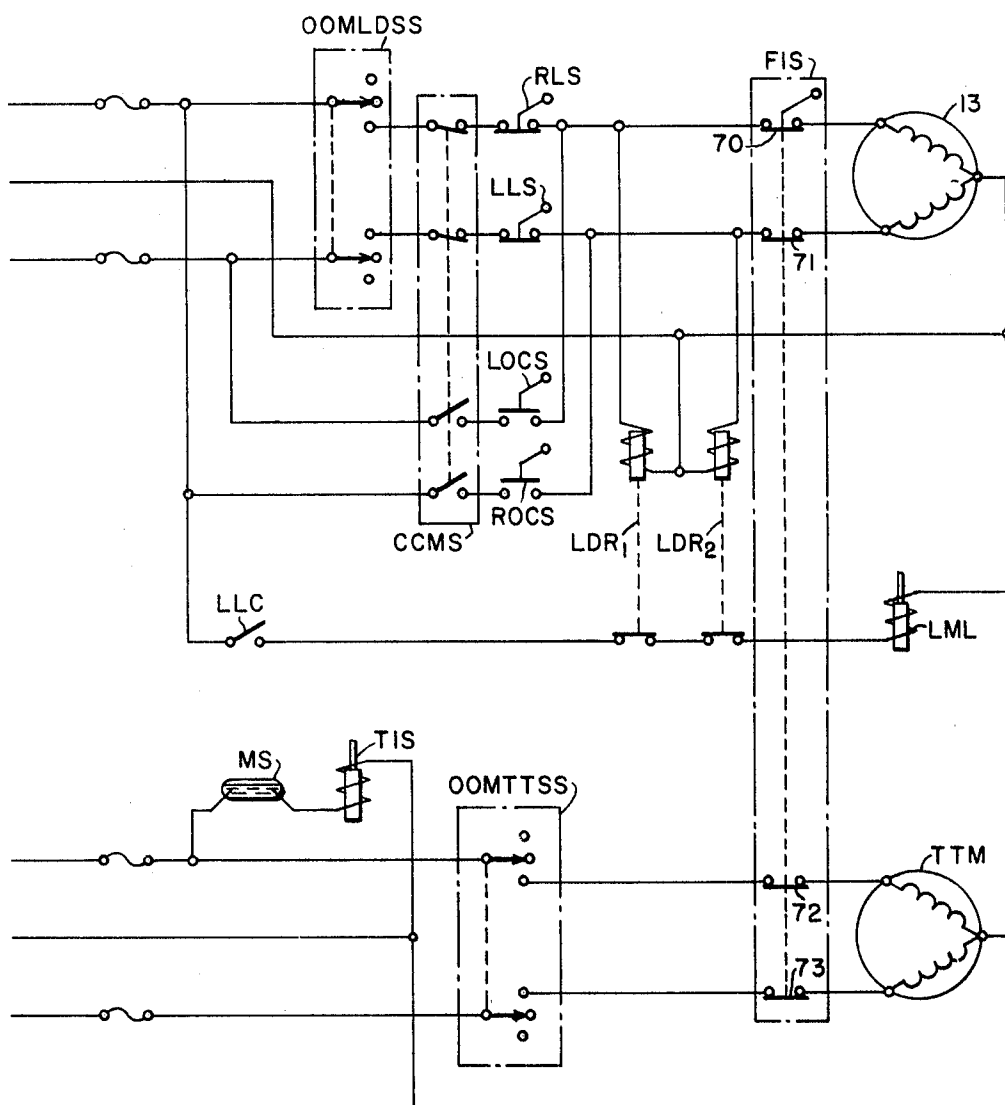


FIG. 15.

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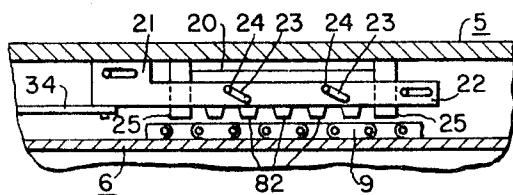


FIG. 16.

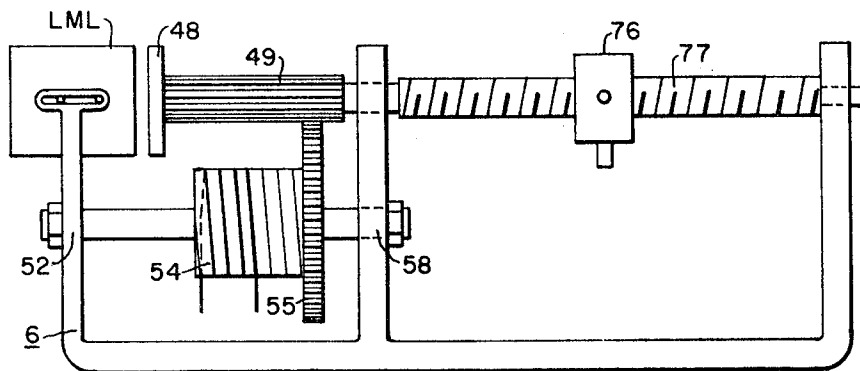


FIG. 17.

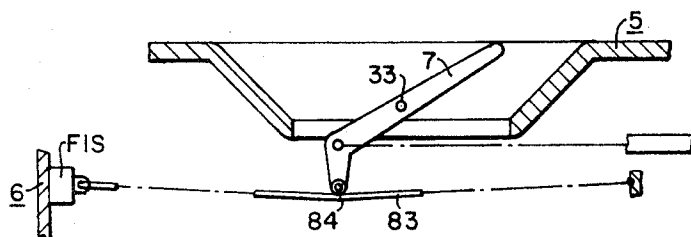


FIG. 18.

X-RAY TABLE WITH SELECTIVE FLOAT AND POWER DRIVE TOP

BACKGROUND OF THE INVENTION

1. Field of the Invention

Movable-top tiltable diagnostic X-ray tables.

2. Description of the Prior Art

Tops, (top sections) on tiltable X-ray tables which are movable relative to the tiltable table bodies contribute significantly to the utility of such tables for diagnostic purposes. When the table is horizontal, a floating support for such top (top section) enables the top to be positioned manually with ease and with a dexterity that is relatively difficult to arrive at by use of powerdrive means. When the table is tilted longitudinally in the well-known manner, however, the table top cannot be permitted to float longitudinally and therefore power drive becomes a necessity where control of longitudinal position of the top is to be preserved in such tilted attitudes of the table.

Previous tiltable X-ray tables having tops movable longitudinally, of which applicant is aware, have either provided a floating top which becomes secured to the table body when the table is to be tilted, or has a powerdrive on the top that permanently locks the top against floating. In either type, a compromise is made with respect to longitudinal positioning of the table top. In the one case, the floating top that is locked when the table is tilted precludes positioning of such top in the tilted table attitudes, and in the other case, the top that must be power driven in the horizontal attitude of the table sacrifices the ease, rapidity and dexterity afforded by manual float positioning.

SUMMARY

The present invention provides a tiltable X-ray table with a top that can be made free to float longitudinally when the table is horizontal, and that can readily be coupled to a longitudinal power drive for use in horizontal as well as tilted attitudes of the table including 90° where a foot stand at the lower end of the table renders such longitudinal power drive effective as a patient elevator. A highly versatile and useful arrangement. Furthermore, such multimode top drive is accomplished in a relatively simple manner that affords effective and safe operation of the system with minimal interference of unobstructed areaway for penetration of X-rays through the table top as is required; a motor-driven chain in form of a simple elongated loop passing around sprocket wheels on horizontal axes at opposite ends of a floating cross-carriage is coupled to the table top by a lever-operated dog which may be engaged or disengaged at will when the table is horizontal for selection of either float or power drive, as desired. The drive chain is disposed near a longitudinal edge of the cross-carriage frame, or two of such chains may be employed, one at the front of the cross-carriage frame and one at the rear, both driven from a common shaft, thereby providing additional support for the table top when tilted and maximizing the safety provided by such dual-chain arrangement.

Another feature of the table of the present invention includes provision of a cable loop anchored to the table top which couples longitudinal movement of such top into rotary movement of a drum in the cross-carriage frame, and a magnet lock for the drum which is effective for locking the top in different selective longitudinal float positions in the horizontal attitude of the table. If desired, such motion-translating cable also can be employed in the control system for power drive of the top where information as to longitudinal position of the top is required for automatic limit-stop and return-to-center positioning.

Yet another feature of the invention resides in the employment of a floating cross carriage which permits of manual positioning of the table top forwardly and rearwardly in both horizontal as well as tilted attitudes of the table.

Still further, the control means for the table are such as prevent tilting of the table while the top is disengaged from the longitudinal powerdrive chain means, and, in tilted table attitudes, prevents disengagement of the top from such chain means while permitting powered positioning thereby.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a tiltable X-ray table embodying the invention;

FIG. 2 is a fragmentary front elevation view, partly in outline and partly in section, showing details of a longitudinal drive chain taken along the line 2-2 of FIG. 1;

FIG. 3 is a similar view taken along the line 3-3 in FIG. 1, showing details of the drive motor arrangement for the drive chain of FIG. 2;

FIG. 4 is a plan view, partly in outline and partly in section, of the top of the cross-carriage frame showing disposition of a preferred drive chain arrangement;

FIG. 5 is a fragmentary elevation view, partly in outline and partly in section, showing details of a roller bearing arrangement employed in the floating support system for the cross-carriage frame;

FIG. 6 is a fragmentary elevation view, partly in outline and partly in section, of one form of disengageable dog means for coupling the table top to the longitudinal drive chain;

FIG. 7 is a fragmentary elevation view of a roller bearing arrangement employed in a floating support means for the table top;

FIG. 8 is a fragmentary plan view of the cable-loop-and-drum arrangement for translating longitudinal movement of the table top into rotary movement of a drum with which a brake is affiliated to lock the longitudinal float positions of such top;

FIG. 9 is a fragmentary plan view of switch mechanism within the cross-carriage frame for controlling longitudinal powerdrive of the table top;

FIG. 10 is a fragmentary plan view of one end of the cross-carriage frame in which resides table-tilt interlocking mechanism conditioned by float-drive mode selector mechanism in the table top when in a center position on the table body;

FIG. 11 is a fragmentary elevation view, partly in outline and partly in section, showing details of an interlock switch device embodied in the mechanism of FIG. 10;

FIG. 12 is a bottom view of the table top showing details of the lever-operated mechanism for controlling engagement and disengagement of such top with a pair of longitudinal drive chains along the front and rear of the cross-carriage frame such as shown in FIG. 4;

FIG. 13 is a fragmental plan view of the center portion of the table top showing details of a manually operated lever for the powerdrive-engaging mechanism of FIG. 12, including an interlock arrangement which prevents operation of the lever in other than longitudinal center position of the table top;

FIG. 14 is a sectional elevation view taken along the line 14-14 in FIG. 13;

FIG. 15 is a circuit diagram of significant portions of a control system for the X-ray table of the present invention;

FIG. 16 is a fragmentary elevation view, partly in outline and partly in section, of an alternate construction of a disengageable dog means for coupling the table top to the longitudinal drive chain in any longitudinal position of the top;

FIG. 17 is an elevation view of an alternate arrangement for actuating the powerdrive-controlling switch mechanism of FIG. 9 which is complementary with the form of dog means shown in FIG. 16; and,

FIG. 18 is a fragmental plan view similar to FIG. 13 showing an alternate arrangement for sensing the position of the manually operated power drive control lever for interlock control purposes.

In the foregoing and hereinafter, where the several views are referenced to vertical and horizontal directions, it will be

presumed that such is with reference to the table being in horizontal attitude as shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the X-ray table 1 in which the invention is embodied is of the type having a body 2 carried by a floor-mounted base 3 through the medium of a rotary support means (not shown) that provides for tilting of the body 2 longitudinally about a horizontal axis 4 by operation of a motorized mechanism (not shown) that also effects translation of such table body longitudinally during tilting as required to enable the end of the table to clear the floor and the table to assume up to a vertical attitude, usually in either direction; such table tilting and translating mechanism being well known and of various suitable constructions. The usual tiltable X-ray table also includes an X-ray tube (not shown) mounted inside the table body 2 which is similarly movable within the table for positioning X-rays upwardly through selected regions of the table top 5 according to location of regions of the patient (not shown) resting on such top which are made subject to examination. A bucky tray (not shown) also is usually included which is similarly movable within the table for positioning X-ray sheet film employed in conjunction with an X-ray tube (not shown) aimed through the table top 5 from the exterior of the table.

In accord with features of the invention, the table top 5 is mounted for floating movement longitudinally on a cross-carriage frame 6 which in turn is mounted for floating movement laterally on the table body 2. By selective positioning of a manually operated mode selector lever 7 at the front center of the table top 5 while the table is horizontal, the table top can be coupled and uncoupled from longitudinal powerdrive chain means 8, FIG. 2, disposed in the cross-carriage frame 6, to selectively obtain both float and powerdrive for longitudinal movement of the top 5 when horizontal.

In accord with the illustrative embodiment shown in the drawings, the drive chain means 8 comprises two similarly arranged chains 9, one along the front of the cross-carriage frame 6, and one along the back of such frame, FIGS. 2, 3 and 4; although as a practical matter one of such chains at either front or back, alone could be made to perform satisfactorily. Each chain 9 is in the form of a single loop disposed in a vertical plane which passes around a drive sprocket wheel 10 at one end of the cross-carriage frame 6 and an idler sprocket wheel 11 at the opposite end of such frame. The two sprocket wheels 10 and 11 are arranged to direct the upper side of the loop so as to dispose the respective section of chain 9 along the adjacent frame edge and in coincidence with the upper edge of the frame in exposure to the under side of the table top 5. Guide sprockets 12 (FIGS. 1 and 2) provide narrowing of the chain loops to minimize the vertical space requirements in the frame 6 necessary to accommodate their end-to-end extension therein. A reversible motor and gear drive mechanism 13 disposed on a bracket 14 attached to the cross-carriage frame 6 and extending downwardly into the table body 2, is coupled to a drive shaft 15 for sprocket wheels 10 which is journaled in such frame, via a drive chain 16 and sprocket wheels 17 and 18 affiliated with mechanism 13 and shaft 15, respectively.

In one embodiment of the invention, a center section of each chain 9 in its upper region exposed to the underside of the top 5 is provided with a rigid socket member 19 (FIGS. 2 and 6) which is engageable by a dog 20 projecting downwardly from the table top 5, when the table top is centered longitudinally on the frame 6. The dog 20 is engaged and retracted by the mode selector lever 7 on the table top 5 via a yoke member 21 (FIG. 6) having flat arms 22 disposed in sliding relationship with front and back surfaces of the dog 20. Each arm 22 has a pair of slanted slots 23 which extend vertically and along the arm and in which pins 24 projecting from the respective dog 20 extend. Forward and rearward ends of the dog are in vertically guided slidable relationship with guide

members 25 projecting downwardly from the table top 5. By longitudinal actuation of the yoke member 21, the slots 23 in its arms 22 cause the pins 24, hence the dog 20, to move up and down according to the direction of movement of such yoke member, for causing such dog to engage and disengage the socket member 19 on the chain 9; thereby engaging and disengaging the table top 5 from the respective longitudinal power drive chain. The upper legs of the chains 9 which are exposed to the underside of the table top 5 are slidably supported on an elongated chain support members 28 which extend along the cross-carriage frame 6 to absorb thrust exerted by the dogs 20 downwardly against the socket members 19.

Referring to FIG. 12, the mode selector lever 7 is operatively connected to the yoke members 21 for actuating the dogs 20 vertically by way of a flat linkage member 30 which extends along the underside of the table top 5 near its front edge and is pin connected at one end to an inner end of such lever and at its opposite end to an outer edge portion of a rotary member 31 pivotally connected to the table top at its center 32. Pivotal movement of the lever 7 about a mounting pin 33 on the table top 5 causes the linkage member 30 to move longitudinally and turn the rotary member 31 about its center 32. Such rotary movement of member 31 in turn is transmitted to the yoke member 21 at front center of the top by way of a pin-connected linkage member 34, and to the yoke member 21 at rear center of the table top by way of a laterally extending interconnecting linkage member 35 at one end of the table top, a second rotary member 36 rotarily connected at its center 37, and a pin-connected linkage member 38 extending along the rear of the table top.

When the table top 5 is disengaged from the drive chain means 8, which can exist only when the table is horizontal as will become apparent from subsequent description, it is free to float longitudinally on roller bearings 40 (FIG. 7) on front and back undersides of the table top which are in rolling contact with the top, bottom, and edge of a track 41 which extends along the upper forward and rearward edges of the cross-carriage frame 6. At the same time, the cross-carriage frame is also free to float backwardly and forwardly on rollers 42 (FIGS. 4 and 5) disposed on such frame at left and right ends thereof (only the left end rollers being shown) and in rolling engagement with top, bottom, and inner edge of a bar-shaped guide track 43 at the upper end edges of the table body 2.

Locking of the cross-carriage frame, hence the table top, in selected transverse positions on the table body is accomplished by a magnet lock means 44 mounted on the table body 2 (FIG. 3) and attracted into locking contact with a member 45 of the cross-carriage frame 6 when energized in the well-known manner.

Locking of the table top 5 in selected longitudinal float positions on the cross-carriage frame 6, is effected by energization of a magnet lock LML (FIG. 8) which engages a disc 48 on one end of an elongated spur gear 49 which is journaled at 50 and 51 to portions of the frame 6 near its one end and which is coupled to the table top to be turned by longitudinal movement thereof along the frame 6 via a loop of cable 52 that passes around a pulley 53 at the opposite end of frame 6 and extends along a top edge thereof to a spirally grooved drum 54 around which a number of turns of such cable are wrapped and which is rotationally coupled to spur gear 49 via a gear 55 at one end of the drum. The drum 54 is mounted for rotary and axialwise-sliding movement on a shaft 56 secured at 57 and 58 to portions of the frame 6. A pair of pulleys 59 and 60 guides the cable 52 onto and off of the drum 54 which turns and floats axially during simultaneous reel in and payout of cable from the drum by longitudinal movement of the top 5 on the frame 6 by virtue of connection of the cable 52 to the top 5 at an anchor point 61. During such rotation of the drum as effected by cable travel around the drum during longitudinal top movement, the top may be arrested in movement and locked when desired by the operation of the magnet lock LML which restrains the gear 49, hence the drum 54, hence the cable 52, and hence the top 5.

When the table top 5 is locked into engagement with the longitudinal drive chain means 8 on the cross-carriage frame 6, which can be effectuated only when the table is horizontal as will be understood from subsequent description, operation of the motor-gear drive mechanism 13 (FIGS. 3 and 4) will actuate the chains 9 along their loop paths at front and rear of the cross-carriage frame 6 and cause the table top 5 to be driven longitudinally along such frame via the dogs 20 on the underside of the table top and the socket members 19 on such chains, in one direction or the other according to direction of operation of such motor-gear drive mechanism. Stopping of such motor-gear drive mechanism automatically locks the table top in a corresponding position due to the self locking characteristic of such mechanism.

In such embodiment as above described, where the table top 5 can be connected to the drive chains 9 only at the location of the socket members 19, it becomes important to recognize the position of such socket members when the table top is to be coupled thereto. Since these socket members are located under the table top at the top of the frame 6, they cannot be readily observed, and the problem of their location for coupling availability is solved by permitting engagement and disengagement of the dogs 20 on the top 5 with the socket members 19 on the chains 9 only when the top is longitudinally centered on the frame 6, and by preventing operation of the longitudinal drive motor-gear mechanism 13 when the table top is disengaged from such chains.

The former is accomplished by a mechanical interlock affiliated with the mode selector lever 7 in the table top 5, as exemplified in FIGS. 13 and 14, where a vertically extending pin 63 on the inner end of such lever must be able to pass in and out of a downwardly extending slot 64 in the top of a wall member 65 of the frame 6, which slot is located at the longitudinal center of such frame. Exertion of a slight effort on the lever 7 as the top is rolled along the frame 6 while floating will slide the pin 63 along the outside of frame member 65 until the pin 63 can pass through the slot 64.

Prevention of chain drive during floating of the table top is accomplished by a float interlock switch FIS shown in FIGS. 10 and 11 which is actuated by a pin 67 projecting downwardly from the connecting linkage member 35 (FIG. 12) in the engaging control mechanism in the table top. The float interlock switch FIS is disposed in the frame 6 at its one end and is affiliated with a toggle lever 68 that is spring biased to assume one overcenter position in which normally closed contacts 70 and 71 of the float interlock switch are opened to interrupt any energizing circuit for the longitudinal drive motor 13 (FIG. 15) and another overcenter position in which switch FIS is allowed to close. Actuation of toggle lever 68 can be effected only when the table top 5 is centered longitudinally on the frame 6, by virtue of location of the actuating pin 67 on the table top and the location of the toggle lever on the frame. When the top 5 is so centered, the pin 67 on connecting linkage member 35 will project into a yoke at the upper end of the toggle lever 68 and become actuated to its other overcenter position as the pin moves transversely of the top 5 and frame 6 with actuation of the linkage mechanism in the top by operation of the mode selector lever 7.

The float interlock switch FIS (FIG. 15), in addition to preventing operation of the longitudinal drive motor 13 for the top, also has contacts 72 and 73 that interrupt any energizing circuit for the tilting motor for the table TTM when the table top is floating by virtue of disengagement from the longitudinal drive chains 9.

In addition, controls for operation of the table includes a mercury switch MS (FIG. 15) that energizes a tilt interlock solenoid TIS FIGS. 10 and 15) disposed vertically in the cross-carriage frame 6 to cause a plunger rod 75 to project upwardly into a locking hole 76 in the rotary member 36 of the dog-actuating mechanism in the table top, to prevent dog-disengaging operation of such mechanism by the lever 7 when the table is tilted.

Other control features include LDR₁ and LDR₂ relay switches (FIG. 15) with normally closed contacts that open to interrupt an energizing circuit for the longitudinal magnet lock LML (FIG. 8) for the top when the longitudinal power-drive motor 13 is energized for operation in either direction.

Still further, by actuation of a pair of toggle-arm-operated switches LOCS and ROCS (FIGS. 9 and 15) by a follower nut 76 on a screw shaft 77 driven from either the cable drum 54 (FIG. 17) or via such as gears 78 and 79, the chain drive shaft 15, (FIGS. 2, 3 and 4) information as to location of the table top with respect to longitudinal center is employed in an automatic return-to-center control circuit for powerdrive of the table top (FIG. 15) in affiliation with a centering control manual switch CCMS. normally closed right and left limit switches, RLS and LLS in FIGS. 9 and 15 are disposed in the cross-carriage frame 6 to be operated by the follower nut 76 (FIGS. 9 and 17) to automatically interrupt any energizing circuit for the longitudinal drive motor 13 when the table top 5 reaches the end of its longitudinal travel. An on-off manual selector switch OOMLDSS (FIG. 15) provides for selective establishment of right and left energizing circuits for the longitudinal drive motor 13 for the table top.

In lieu of the aforedescribed arrangement for coupling the table top to the longitudinal drive chains 9 via socket members 19 in such chains, it may be preferred to provide a dog 20, as in FIG. 16, having a series of teeth 82 for locking engagement with the chains without any special localized adaptation thereof. In this manner, the top may be coupled and uncoupled to the cabins 9 by operation of the mode selector lever 7 at any longitudinal location along the table top, in which case the center-position-requiring mechanical interlock affiliated with lever 7 as shown in FIG. 13 will be dispensed with, and the float interlock switch FIS (FIG. 15) will be operated by other than a center-position-requiring arrangement as in FIGS. 10 and 11, and rather by a means, such as a cable 83 (FIG. 18) extending along the front upper edge of the cross carriage frame 6, which will be tension-conditioned by a pin 84 on the end of lever 7, so arranged as to distinguish between power drive and float positions of such lever irrespective of the longitudinal position of the top on the frame. It will be appreciated that the tilt interlock solenoid TIS of FIG. 10 would no longer be effective to prevent disengagement of the top from the drive chain in tilted table attitudes, and would either require relocation or to be replaced by other means (not shown).

I claim:

1. An X-ray table comprising,

a floor mounted base,

an elongated normally horizontal table body tiltable longitudinally on said base,

tilt motor means for said body,

an elongated cross-carriage frame extending lengthwise along the length of the top of said body in transversely floating support thereon,

an elongated table top extending lengthwise along the length of said frame in longitudinally guided friction-free connection therewith,

reversible motorized longitudinal powerdrive means capable of being coupled between said frame and said table top to effect relative longitudinal movement of said top when activated and locking such top to said frame when deactivated, and of being uncoupled to permit floating longitudinal movement of said top on said frame,

operator-controlled power control means for selectively activating and deactivating said powerdrive means in selected directions,

operator-controlled mode selector means for selectively coupling and uncoupling said powerdrive means,

first interlock means preventing operation of said tilt motor when said powerdrive means is uncoupled, and

second interlock means preventing uncoupling of said power drive means when the table body is tilted.

2. The X-ray table of claim 1, wherein,

the motorized longitudinal powerdrive means is disposed in said crosscarriage frame and comprises

a self-locking electric-motor-and-gear-reducer mechanism at one end of said frame connected to a drive sprocket wheel means, and drive chain means looped in a vertical plane and extending around said drive sprocket wheel means, along an upper longitudinal edge of said frame, around idler sprocket wheel means at the opposite end of said frame, and back along said frame to said drive sprocket wheel means, and,

said operator-controlled mode selector means is disposed in said table top and includes retractable dog means actuable into and out of engagement with the uppermost chain loop portion, and a mode selector lever operatively connected to said dog means.

3. The X-ray table of claim 2, wherein said dog means is at the longitudinal center of said top, said chain means includes socket member means in its upper chain loop portion to receive said dog means, and such table further comprises,

third interlock means for preventing actuation of said dog means when said table top is not longitudinally centered on said cross-carriage frame, and

fourth interlock means preventing activation of said power drive means when uncoupled.

4. The X-ray table of claim 3, further comprising operator-effectuable automatic return-to-center control means for controlling activation of said reversible motorized longitudinal power drive means.

5. The X-ray table of claim 1, further comprising, magnet lock means energizable to lock said cross-carriage frame in

selected transverse float positions on said table body.

6. The X-ray table of claim 1, further comprising, longitudinal travel-restraining means for said table top including electromagnet means for effectuation during floating movement mode of table top actuation,

interlock means cooperable with said electromagnet means for ineffecting said longitudinal travel-restraining means responsively to activation of said power drive means.

7. An X-ray table comprising a top supported on a frame having therein,

a rotatable friction disc,

a magnet brake energizable to engage said disc to restrain rotation thereof,

an elongated spur gear having a rotary coupled connection with said discs,

a spirally grooved rotatable drum floatable axialwise, disposed parallel to said elongated spur gear, and coupled thereto via a coaxial gear attached to said drum,

remote direction-reversing pulley means,

a cable loop passing around said direction reversing pulley means and extending to and around said drum in multiturn spiral-wound relationship thereon,

fixed location pulley means for directing travel of such cable loop to and from said drum,

an anchor means securing said table top to a point on said cable loop,

and means on said frame guiding movement of said top along a path of travel parallel to the general direction of cable loop extension between the two pulley means.

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