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TUBE STAND FOR X-RAY APPARATUS

Filed Dec. 11, 1943

4 Sheets-Sheet 1

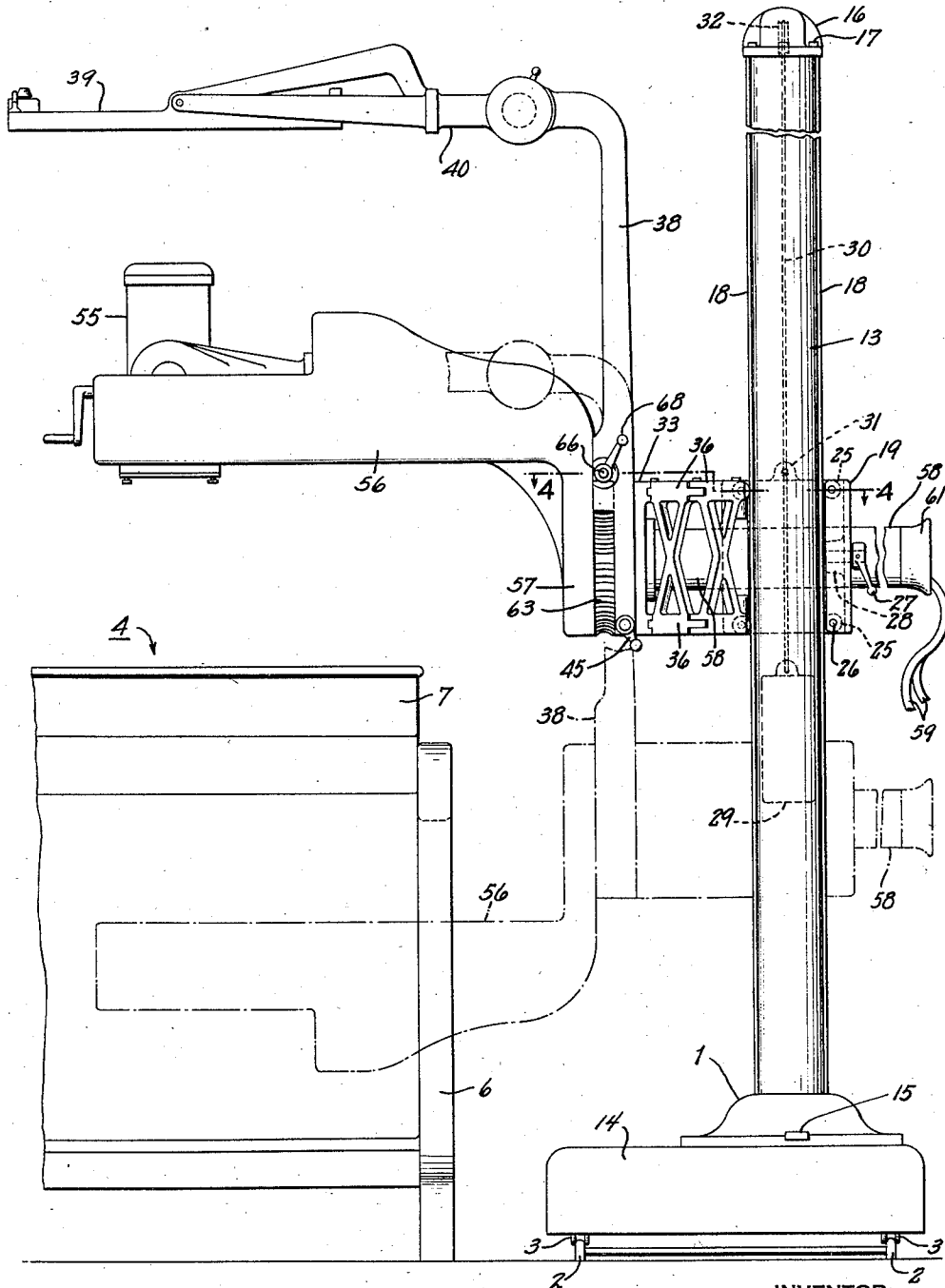


Fig. 1

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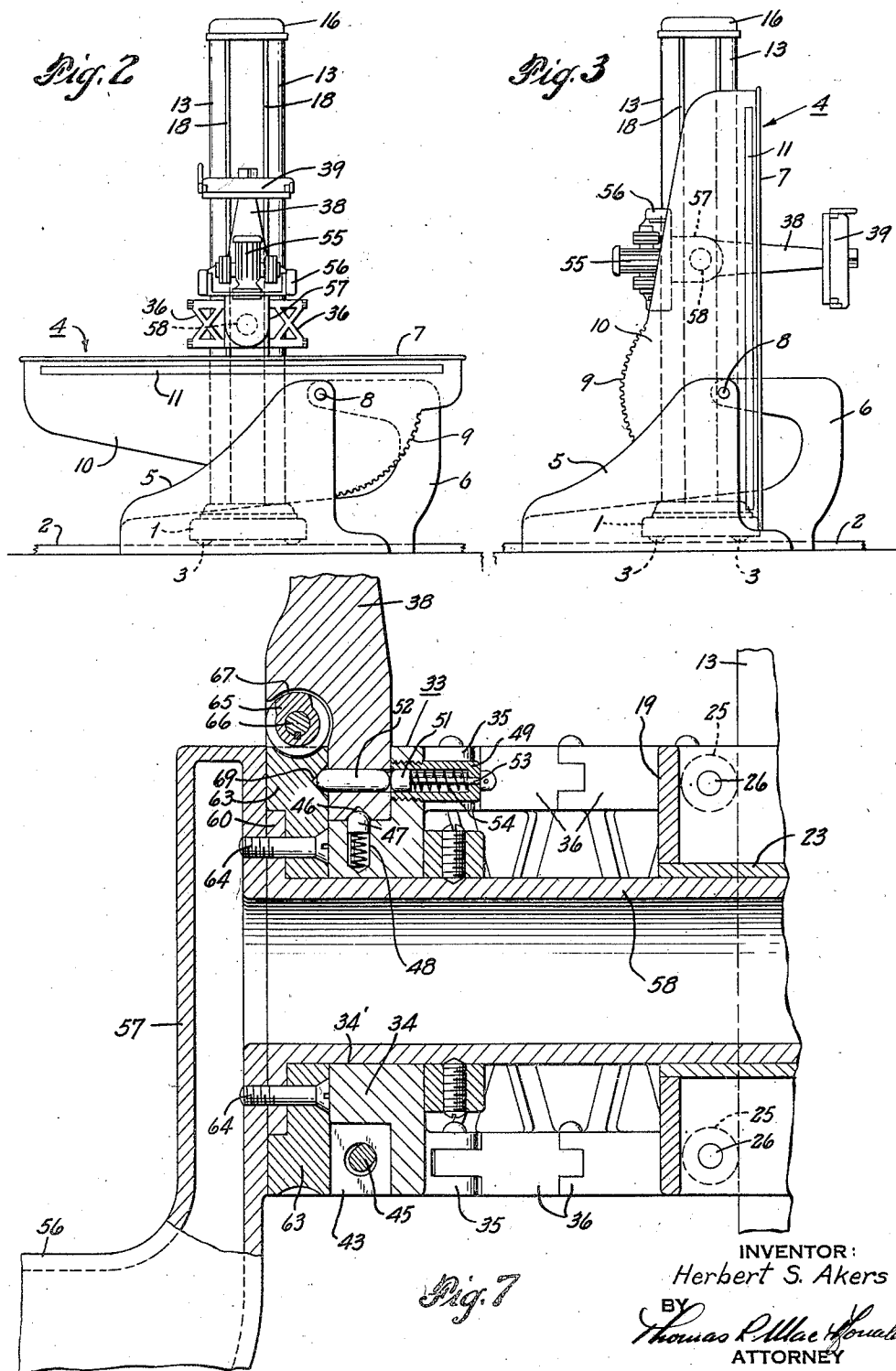
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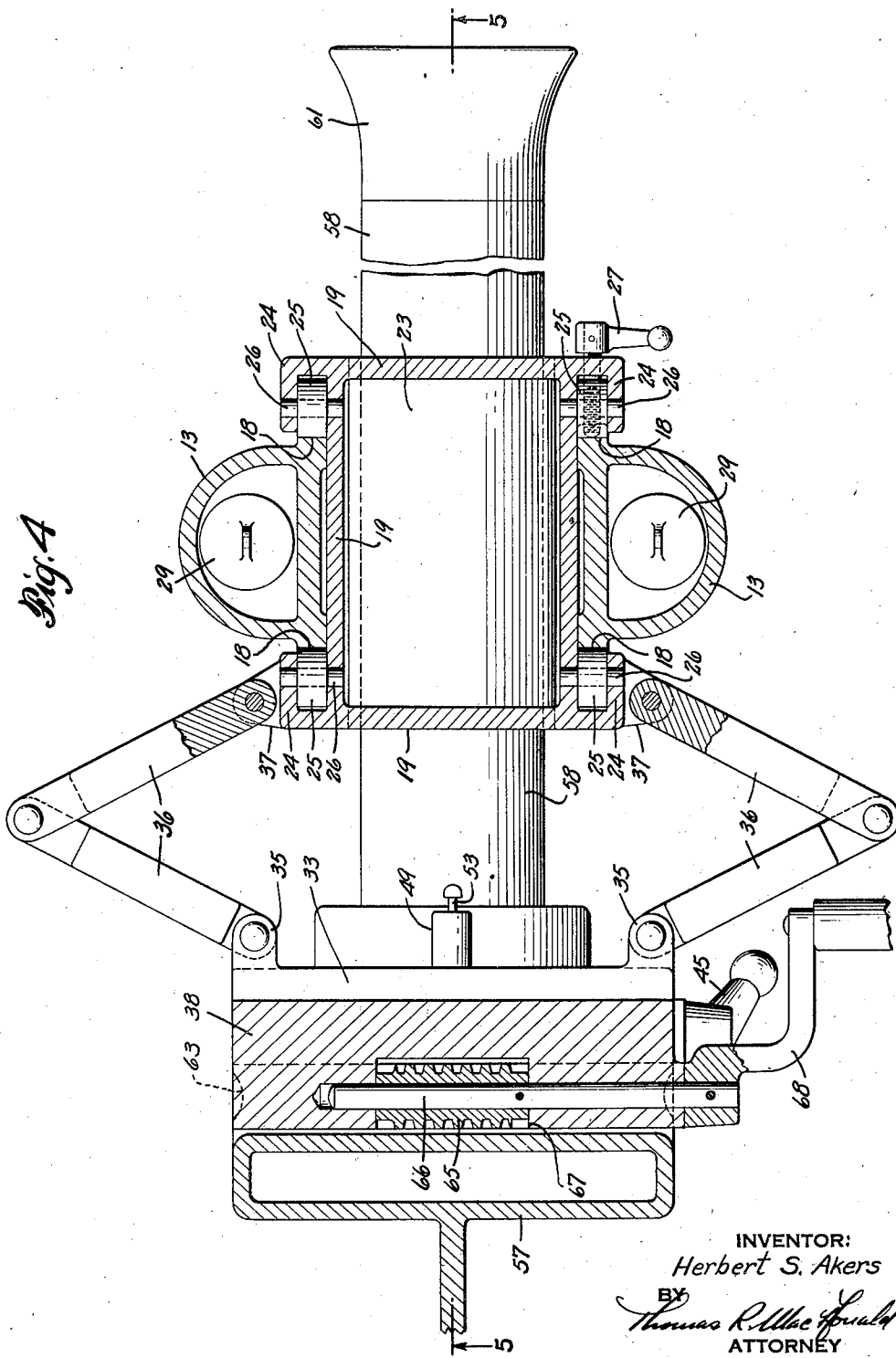
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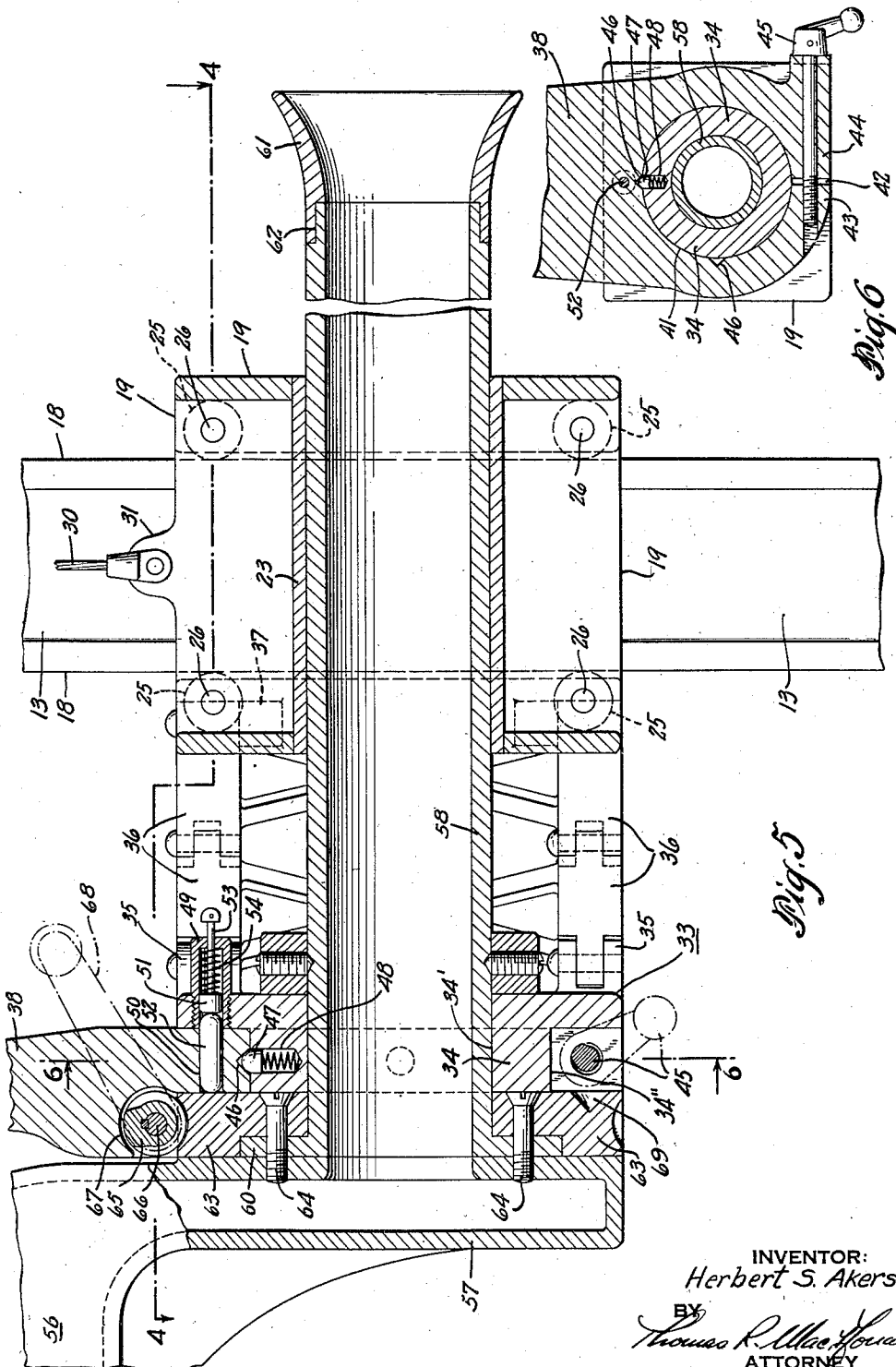
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TUBE STAND FOR X-RAY APPARATUS

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6 Claims. (Cl. 250—52)

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This invention relates to a new and useful improvement in tube stands and more especially to new and useful improvements in the tube stands of X-ray apparatus.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate embodiments of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Fig. 1 is a view in side elevation of a tube stand in accordance with this invention showing the X-ray tube assembly and screen assembly positioned for the making of a radiographic study;

Fig. 2 is a view in front elevation of the tube stand of Fig. 1 showing the same arrangement;

Fig. 3 is a view in front elevation of the tube stand of Fig. 1 showing the X-ray tube assembly and screen assembly positioned for the making of a fluoroscopic study;

Fig. 4 is a view in plan with parts in section of the tube stand of Fig. 1 taken along the line 4—4 of Fig. 1 and showing details of the tube-screen carriage structure;

Fig. 5 is a view in elevation with parts in section of the tube stand of Fig. 1, taken along the line 5—5 of Fig. 4 and showing details of the tube-screen locking mechanism;

Fig. 6 is a view in elevation with parts in section of the tube stand of Fig. 1 taken along the line 6—6 of Fig. 5 showing a detail of the locking mechanism; and,

Fig. 7 is a view in elevation with parts in section of the tube stand of Fig. 1 similar to the showing in Fig. 5 but with the tube-screen assemblies positioned for fluoroscopy.

It has been customary to support the X-ray tube and a fluoroscopic screen upon and in adjustable relation to a floor standard so that they may be positioned at will in desired spaced relation to an X-ray table and so that they may be moved laterally with relation to the table.

In the making of radiographic studies with such apparatus, the arrangement of the parts is ordinarily such that the X-ray tube occupies a posi-

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tion between the screen and the X-ray table. On the other hand, in the making of fluoroscopic studies, the X-ray tube and the screen usually occupy positions at either side of the X-ray table. In order that this latter arrangement may be carried out, the tube-screen spacing in the radiographic position where tube and screen are superimposed, must be appreciable. The structural arrangement heretofore employed to obtain the desired spacing presents certain practical disadvantages particularly manifested when it becomes necessary to elevate the X-ray tube materially above the table. In such case, the ceiling height may limit the maximum elevation practically obtainable if the ceiling is so low as to contact the super-imposed screen. Alternative arrangements, such as that of mounting the screen directly on the table, are not wholly remedial since extreme elevation of the X-ray tube is still obtainable only because of the employment of floor stands of considerable height characterized by cumbrousness, minimized mobility, and increased cost.

Lateral adjustment of the X-ray tube and screen relative to the table often presents difficulties particularly in those cases where the X-ray tube is supported by an arm which is slidably mounted in and extends to either side of the floor standard. In such case, the tube stand as a whole must be spaced from an adjacent wall sufficiently to permit full extension or retraction of the support arm. In quarters where space is limited, this condition may present a perplexing and possibly insoluble problem.

Objects of this invention are: to provide a tube stand characterized by freedom from the foregoing disadvantages; to provide a new and improved tube stand for X-ray apparatus; to provide a tube stand which is more suitable for use in quarters where the available space is limited; to provide a tube stand with which an increased elevation of the X-ray tube is obtainable for a given screen setting; to provide a tube stand having a more compact arrangement of the X-ray tube and screen assemblies; to provide a tube stand in which conversion from a radiographic arrangement to fluoroscopic arrangement of the parts may be carried out with improved facility and with minimized effort; to provide a tube stand in which the X-ray tube and screen assemblies may form a balanced rotational system; to provide a tube stand which will permit the use of a tube standard of lower overall height than has heretofore been deemed feasible; and, to provide a tube stand which may be placed in close prox-

imity to a side wall without thereby reducing or restricting in any way the features of lateral adjustability inherent in the stand.

To this end, as at present preferably embodied, a collapsible carriage structure, by which an X-ray tube-assembly and a fluoroscopic screen-assembly are supported for lateral adjustment as a unit is mounted upon and extends laterally from a floor standard for vertical movement relative thereto.

The floor standard is preferably of wheeled construction so that it may be moved easily to a desired position longitudinally of the X-ray table with which it is to be employed. Floor rails for guiding this movement facilitate the operation.

The X-ray tube-assembly and the fluoroscopic screen assembly, which for convenience are sometimes hereinafter referred to as the tube-assembly and the screen assembly, respectively, are journaled in the supporting carriage for rotation relative to each other and to the carriage structure on a common axis, the construction and arrangement of the respective assemblies being such that the X-ray tube and the fluoroscopic screen may, in consequence, be positioned either on the same side of the common rotational axis, or in diametrically opposed relation on opposite sides of the axis, depending on whether radiography or fluoroscopy is the operation to be conducted.

In the radiographic position, both the X-ray tube and fluoroscopic screen are preferably situated above the X-ray table as well as being laterally offset in the same direction relative to the rotational axis.

Since the resultant system is unbalanced about the rotational axis, suitable means are provided to lock one of the assemblies to the carriage until the other assembly is angularly adjusted to a diametrically opposite position in which the system will be in balance, the weights of the respective assemblies being proportioned to achieve this condition. Release of the locked assembly is automatically effected upon establishment of this diametrically opposed angular relationship and the balanced system may then be angularly adjusted as a unit to the desired position for fluoroscopic study.

It will be understood that the foregoing general description, and the following detailed description as well, are exemplary and explanatory, but are not restrictive of the invention.

Referring now in detail to the embodiment of the invention illustrated by way of example in the accompanying drawings, a tube stand 1 is shown mounted on rails 2 by means of flanged wheels 3 for movement longitudinally of an X-ray table 4.

The X-ray table 4, as embodied, is of the tilting type used for radiographic and fluoroscopic studies. As here embodied, the table 4 comprises a pair of parallel side rails 5 and 6 between which the table top 7 is journaled on a shaft 8 terminating in the side rails.

The side rail 6 is C-shaped and laterally offset, as shown, so as to permit movement of an X-ray tube assembly beneath and longitudinally of the table top 7 substantially throughout the length of the table top.

Tilting of the table from the radiographic position in Fig. 1 to the fluoroscopic position of Fig. 3 may be effected manually or through suitable power means, such as an electric motor (not shown), geared to engage and drive a rack 9 of a front side wall member 10 which

depends from the table-member 7. The rear of the table-member 7 is preferably left open to permit entry of the X-ray tube assembly to be described more fully hereinafter. Provision for the use of various auxiliary devices well known in the art such as, for example, a Bucky diaphragm has been made in the form of the diaphragmatic slot 11. Such devices, as well as the particular form and construction of the X-ray table form no part of the present invention, but are referred to merely to illustrate the application of the present invention.

The tube stand 1, as embodied, supports the X-ray tube and screen in vertically and horizontally adjustable relation to the X-ray table 4. As here embodied, a pair of hollow guide members 13 are supported in parallel spaced upright relation by a heavy pedestal member 14 in which the wheels 3 are journaled in any suitable fashion. Provision for locking the wheels to the pedestal member so as releasably to fix the tube stand at any desired position along the rails 2, is made through the inclusion of suitable locking mechanism (not shown) actuable at will by suitable controls, such as, the foot-treadle 15, for example.

The guide members 13 are united at the top by a cap member 16 which is releasably secured thereto by bolts 17. Parallel guide rails 18 are fashioned in each guide member.

Snugly fitted between the opposed faces of the guide members 13 for guided vertical movement therebetween is a hollow carriage member 19.

The carriage member 19, as here embodied, has parallel side and end walls which latter are centrally apertured for the reception of a sleeve bearing member 23 of cylindrical contour which is fixedly secured at either end to the respective end walls. Flanges 24 extend outwardly from the end walls and form U-shaped channels with the side walls in which guide rollers 25 are journaled upon shafts 26.

Locking of the carriage member 19 to the guide members 13 is accomplished by means of a locking member 27 which, as embodied, is carried by the carriage member 19 and is adapted for manual locking engagement with the guide members 13.

The locking member 27, as here embodied, is of bolt form and has a head suitably fashioned to permit manual manipulation, and has a threaded shank. The U-shaped channel formed by one of the flanges 24 and its adjacent side wall is occupied by a dam 28 which is apertured and threadedly receives the locking member 27. Clockwise rotation of the locking member will cause it to enter into frictional locking engagement with the contiguous guide rail 18, so as to lock the carriage member in any desired vertical position.

The carriage member 19 and its appurtenances is counter balanced by suitable devices for the purpose which, as embodied, are enclosed within the hollow guide members 13. As here embodied, counterweights 29 housed within the guide members 13 are connected by cables 30, of which only one is shown, to the carriage member 19. Suitable fittings 31 are provided on the carriage member and the cables 30 are secured thereto. Sheaves 32 journaled in the cap member are traversed by the cables 30 and facilitate the cable movement.

A bearing member 33 is mounted for movement toward and from the carriage member 19. As embodied, the bearing member 33 is fixedly con-

connected to the carriage member 19 by which it is supported. As here embodied, the bearing member 33, of rectangular outline, is centrally cylindrically apertured and is formed with an annular flange portion 34 which is concentric with the central aperture and together therewith provides inner and outer bearing surfaces 34' and 34'', respectively, of cylindrical contour which are co-axial with the sleeve bearing member 23. Bifurcated lugs 35 extend outwardly from and at each corner of the rear face of the bearing member 33 and are connected by hinge arms 36 to lugs 37 correspondingly located on the carriage member 19.

The hinge arms 36, as embodied, not only serve to permit lateral adjustment of the bearing member 33 but also serve to transmit to the journal member 19 whatever torque loads may be imposed on the bearing member 33. Deforming of the hinge structure is avoided by imparting substantial structural rigidity to the hinge arms 36 which, as here embodied, are provided with broad and ample upper and lower chord members and an X-type web.

A screen arm 38 is mounted for rotation on the bearing member and carries at one end a fluoroscopic screen 39.

The screen 39 is pivotally mounted on a hinged section 40 in the usual fashion so that it may be manipulated by the operator in a manner well known to those skilled in the art.

The screen arm 38, as here embodied, is apertured at its opposite end to provide a bearing surface 41 by means of which the screen arm is journaled on the annular flange portion 34 of the bearing member 33. The screen arm is also slotted as at 42 to provide arms 43 and 44 which are adapted to be drawn together so as to clamp the screen arm to the bearing member 33. As embodied, suitable clamping means are provided for this purpose. As here embodied, the shank of a bolt 45 traverses the arms 43 and 44 and threadedly engages the arm 43 so that rotation of the bolt will effect the desired clamping action.

Provision for automatically locating the screen arm 38 in any one of a plurality of predetermined angular positions is made. As embodied, suitable detent means are provided for this purpose. As here embodied, the screen arm 38 is provided with a pair of recesses 46 extending radially outward from the bearing surface 41. The recesses 46 are preferably of conical outline and are circumferentially positioned at 90° to each other to achieve vertical and horizontal locating of the screen arm. A spring pressed detent 47 is reciprocally mounted in a well 48 extending radially inwardly of the flange portion 34 of the bearing member 33. The detent 47 is suitably contoured so as to be smoothly disengageable upon the application of a moderate amount of pressure to the screen arm.

The screen arm 38 is normally locked in the upright unbalanced position shown in Fig. 1 and, as embodied, is releasably secured to the bearing member 33 from which it is automatically released when the unbalanced condition is relieved. As here embodied, the bearing member 33 is provided adjacent its upper extremity, with a casing member 49 which in the position shown in Figs. 5 and 7 is co-axially aligned with an aperture 50 in the screen arm 38. The casing member 49 threadedly engages the bearing member 33 in an aperture therein provided for the purpose and contains a spring-pressed piston 51 which presses against a locking pin 52 slidably received within

the aperture 50. The piston 51 is provided with a shaft 53 encompassed by a coil spring 54 and extending through the casing member 49 so that the piston may be manually retracted as may be advantageous in assembling the apparatus.

It will be observed that while the locking pin 52 lies in part in the casing member 49 and in part in the screen arm 38, as in Fig. 5, that the screen arm cannot be rotated.

An X-ray tube 55 is mounted for rotation about the common axis of the bearings 23 and 33. As embodied, the X-ray tube is radially offset with respect to that axis so that by rotating the tube through an arc of 180°, a substantial increase in the screen-tube spacing is effected and the X-ray tube assembly is utilizable to counterbalance the screen assembly. As here embodied, the X-ray tube 55 is pivotally mounted in a hollow bifurcated L-shaped tube-arm 56 having an apertured depending mounting flange 57.

The arm 56 is carried by a shaft 58 journaled in the bearings 23 and 33. The shaft 58, as embodied, is hollow to permit the passage of high tension cables 59 therethrough which also traverse the interior of the arm 56 to the X-ray tube. As here embodied, the shaft 58 is provided with an annular flange 60 at one end and a detachable end portion 61 at the other end. The end portion 61 is preferably bell-shaped to reduce wear on the cables 59 and is secured to the body of the shaft by a friction joint 62, as shown, although any other suitable form of coupling may be utilized which will facilitate assembling of the shaft in the bearings 23 and 33.

A gear member 63 snugly engages the shaft 58 and bears against the mounting flange 57, the gear member being suitably recessed to accommodate this annular flange 60 within its confines. A plurality of bolts 64 which traverse the gear member 63 and the annular flange 60 threadedly engage the mounting flange 57 and secure these elements together for rotation as a unit.

The gear member 63 is circumferentially toothed to provide a geared surface which, as embodied, is engaged by a driving gear 65 carried by the screen arm 38. As here embodied, the gear member 63 is a worm gear and the gear 65 is a worm so that an irreversible gear train is obtained.

The worm gear 65 is keyed to a shaft 66 which is journaled in the screen arm 38, a recess 67 being provided in the screen arm to accommodate the gear 65 in operative engagement with the spur gear 63.

A hand-crank 68 is secured to the shaft 66 so that the gear 65 may be rotated to drive the spur gear 63 and thereby effect an angular adjustment of the tube arm 56 in either direction of rotation of the hand-crank.

A recess 69 is provided in the gear member 63 in diametrically opposite relation to the locking pin in the upright position shown in Fig. 5. The recess 69 is of a depth and position such that when the tube arm 56 is angularly adjusted through an angle of 180° from the position shown in Fig. 5 to the position shown in Fig. 7, the recess will be axially aligned with the locking pin 52 and will permit entry of the locking pin therein so that the locking pin will just clear the bearing member 33 and release the screen arm 38 from the bearing member 33. The recess 69 is preferably of conical outline, the tip of the locking pin 52 being suitably contoured to co-act therewith so that a predetermined relative movement of the screen arm 38 and tube arm 56 will effect a displacement

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of the locking pin from the recess and again lock the screen arm 38 to the bearing member 33.

The weights of the screen assembly and the tube assembly are suitably proportioned relative to each other so that with the screen and tube in the fluoroscopic position as in Fig. 7, the resultant system will be statically balanced about the rotational axis which passes through the bearing members 23 and 33. Thus, the system may be easily angularly adjusted with but a slight amount of pressure being required by the operator to effect the adjustment.

The system when so balanced may be locked in any desired position by turning the locking member 45. Horizontal or vertical positioning of the system is accurately and automatically attained by means of the operation of the detent 47 and the co-acting recesses 46. Vertical adjustment of the system is effected by releasing the carriage 19 through manipulation of the locking member 27 and manually positioning the carriage 19 at the desired level, the operation being made with ease by reason of the counterbalancing action of the weights 29. Lateral adjustment of the system is rendered possible through the hinge arms 36 provided for the purpose.

The invention in its broader aspect is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

I claim:

1. An X-ray tube stand including in combination a vertically adjustable carriage structure; a screen assembly and an X-ray tube assembly carried by said structure for relative rotation on a common axis, said assemblies respectively supporting X-ray generating means and fluoroscopic screen means in radially offset relation to said axis; means for releasably securing one of said assemblies to said structure, said means being actuable so as to release said assembly upon angular displacement of the other of said assemblies to a predetermined angular position; and, means for effecting relative angular movement of said assemblies.

2. An X-ray tube stand including in combination a vertically adjustable carriage structure; a fluoroscopic screen assembly and an X-ray tube assembly carried by said structure for relative rotation on a common axis, said assemblies respectively supporting X-ray generating means and fluoroscopic screen means in radially offset relation to said axis; means for effecting relative rotation of said assemblies on said axis; means for releasably securing one of said assemblies against rotation, said means being actuable to release said assembly for rotation when said X-ray

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generating means and said screen means are in diametrically opposed relation, said assemblies forming a statically balanced rotational system when said X-ray generating means and said screen means are in said diametrically opposed relation.

3. An X-ray tube stand in accordance with claim 2 including means for locking the balanced rotational system in any desired angular position.

4. An X-ray tube stand in accordance with claim 2 in which said carriage structure is horizontally adjustable.

5. An X-ray tube stand in accordance with claim 2, said securing means comprising a pin reciprocally mounted in one of said assemblies, the other of said assemblies and said carriage structure having openings in axial alignment with said pin in one position of said system.

6. An X-ray tube stand comprising upright guide members in spaced relation; an apertured carriage member mounted between and confined by said guide members for movement vertically thereof; a bearing member having an aperture coaxial with the aperture in said carriage member; hinge means flexibly connecting said bearing and carriage members for enabling movement of the bearing member toward and away from said carriage member; a shaft passing through said apertures, said shaft being journaled in said bearing member and being journaled and reciprocally mounted in said carriage member; a tube arm carried by said shaft, said arm having a tube mounting portion in spaced radially offset relation to said shaft; a screen arm journaled on said bearing member, said screen arm having a screen mounting portion in radially offset relation to said shaft; and means for effecting relative rotation of said arms, said arms in the diametrically opposed position of their respective mounting portions forming a statically balanced rotational system.

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