July 1, 1930. J. R. KELLEY 1,768,769

X-RAY PHOTOGRAPHIC APPARATUS

Filed Feb. 21, 1925 4 Sheets-Sheet 1

Fig. 1.

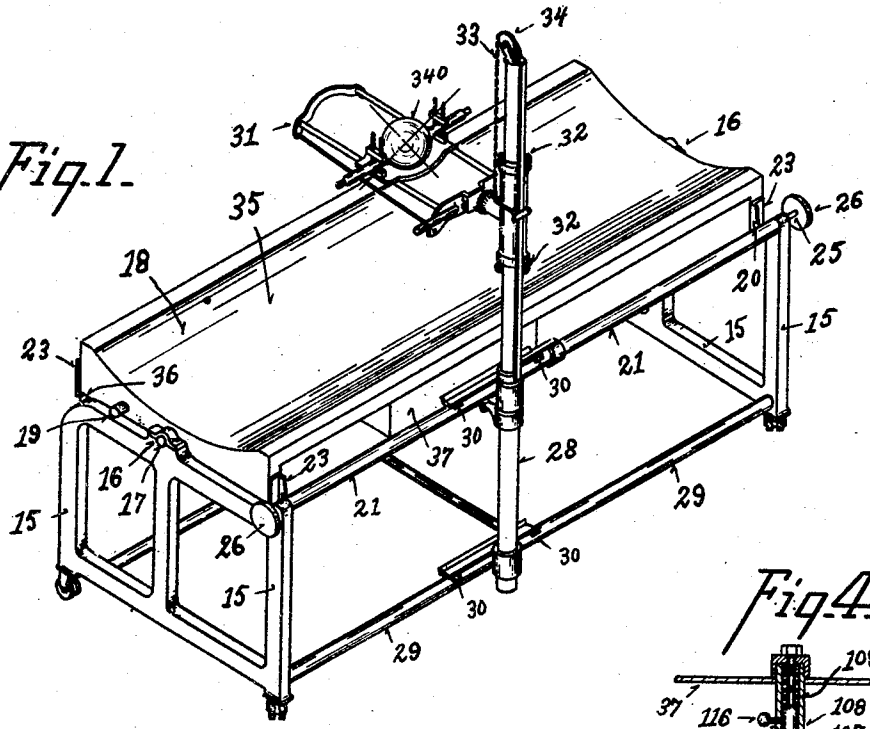


Fig. 4.

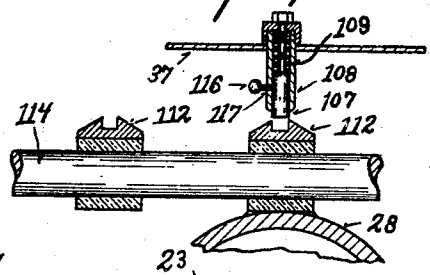


Fig. 2.

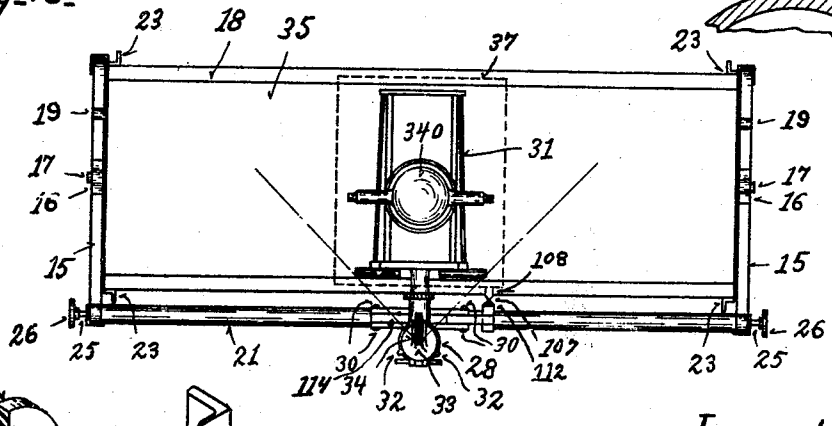
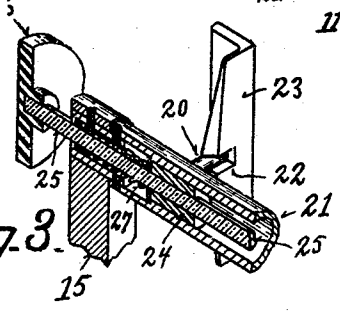


Fig. 3.



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X-RAY PHOTOGRAPHIC APPARATUS

Filed Feb. 21, 1925 4 Sheets-Sheet 2

Fig. 5.

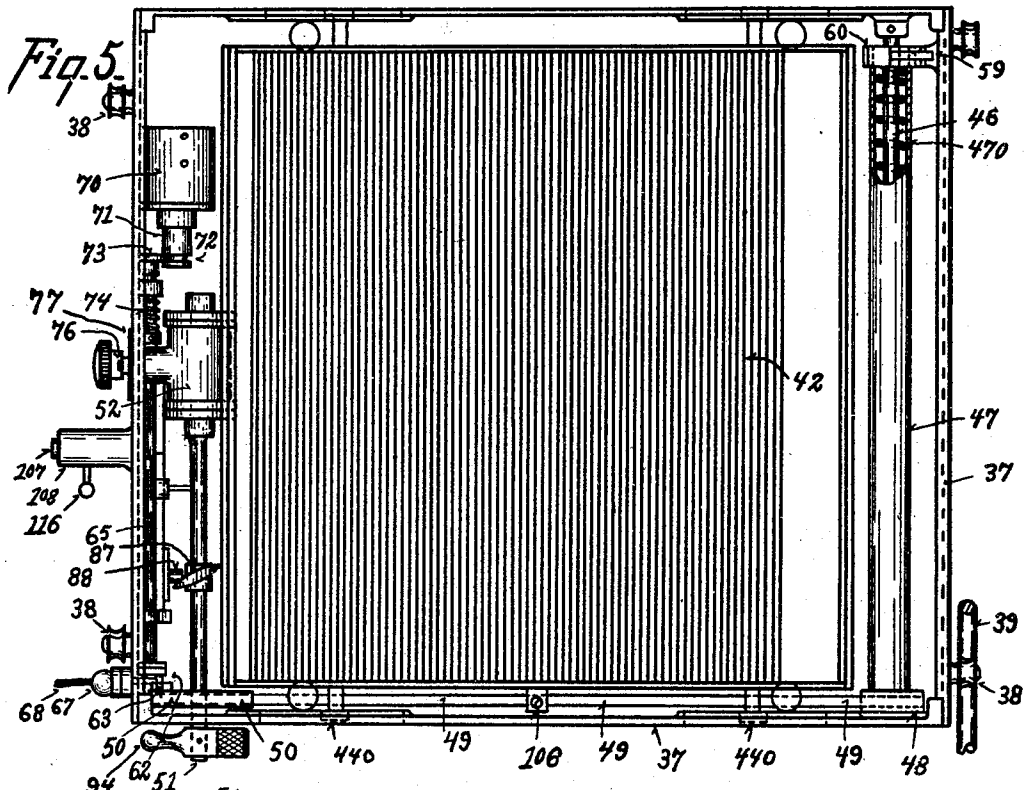


Fig. 6.

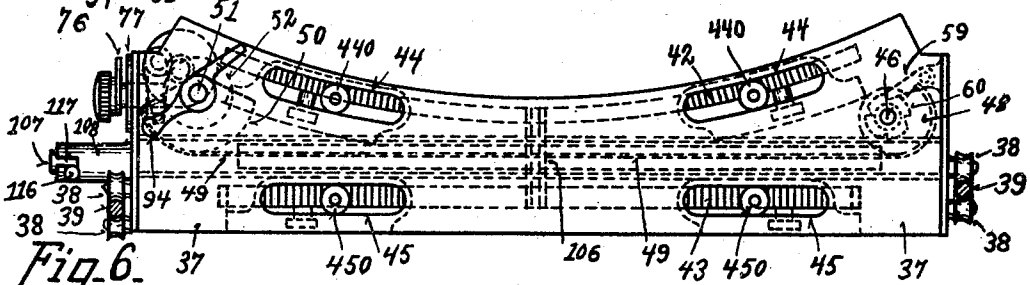
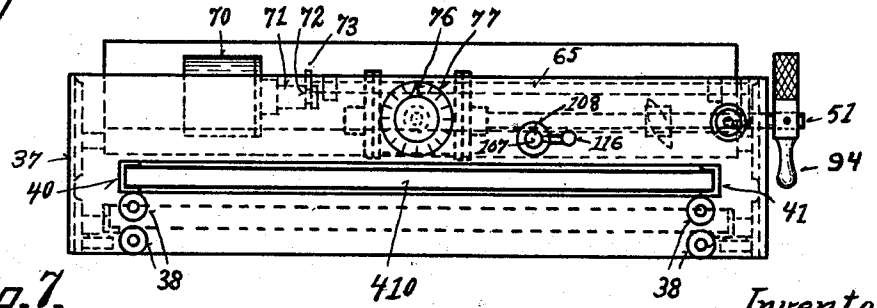


Fig. 7.



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X-RAY PHOTOGRAPHIC APPARATUS

Filed Feb. 21, 1925 4 Sheets-Sheet 3

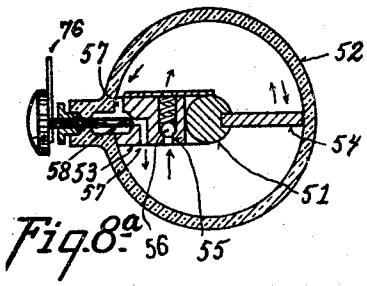


Fig. 8a.

Fig. 8.

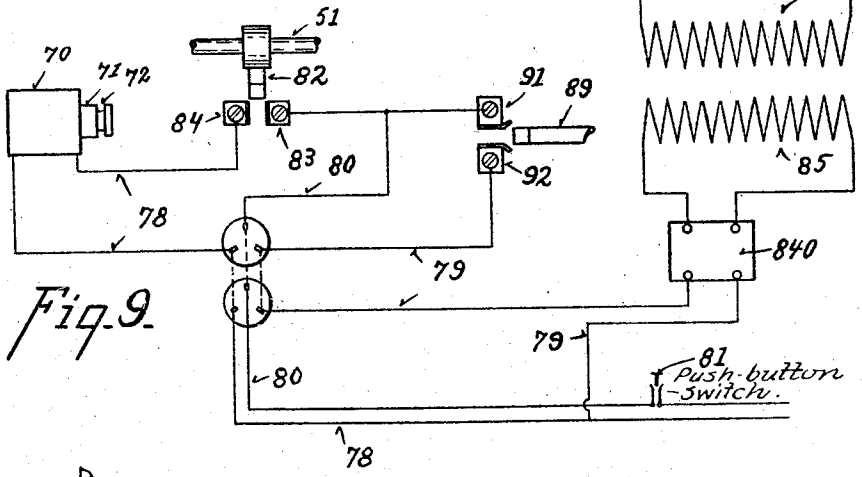


Fig. 9.

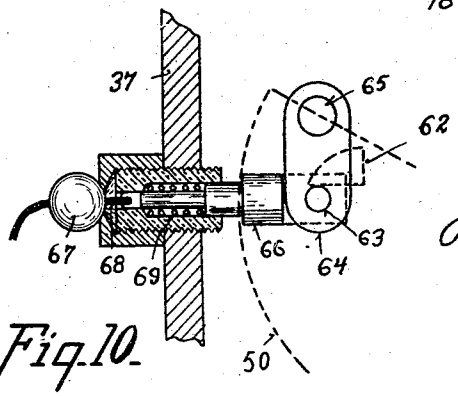


Fig. 10.

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X-RAY PHOTOGRAPHIC APPARATUS

Filed Feb. 21, 1925 4 Sheets-Sheet 4

Fig. 11.

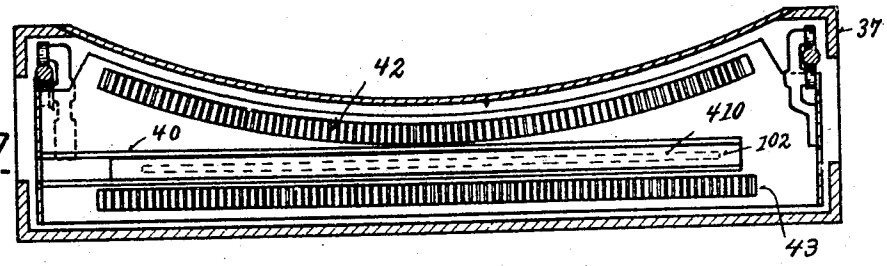


Fig. 12.

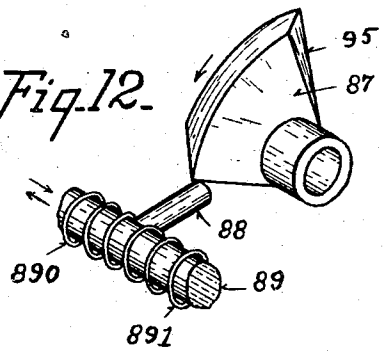


Fig. 13.

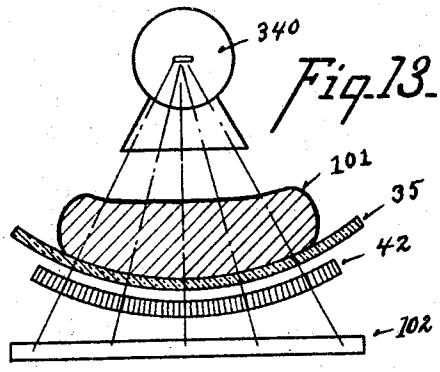


Fig. 15.

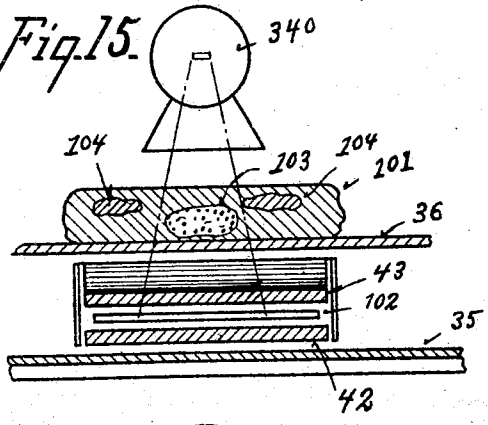


Fig. 14.

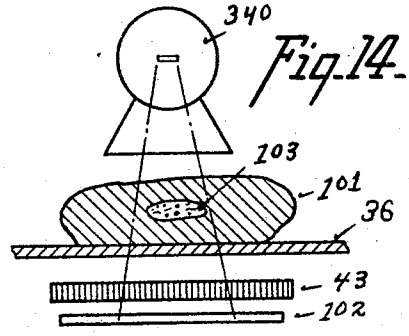
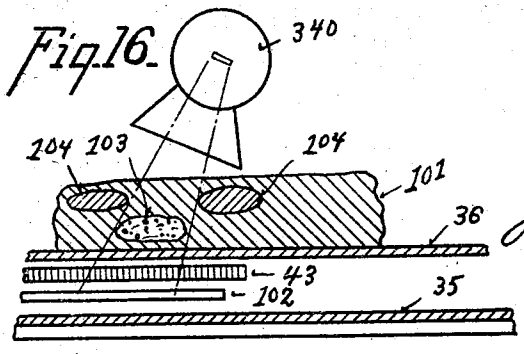


Fig. 16.



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UNITED STATES PATENT OFFICE

JOHN ROBERT KELLEY, OF COVINGTON, KENTUCKY

X-RAY PHOTOGRAPHIC APPARATUS

Application filed February 21, 1925. Serial No. 10,961.

My invention relates to improvements in apparatus for taking X-ray photographs. One of its objects is to provide improved apparatus to support the X-ray tube and the subject to be photographed with reference to the sensitive plates. Another object is to provide in combination with an X-ray tube a reversible table to support both the sensitive plate and the subject to be photographed. Another object is to provide for X-ray purposes an improved plate holder and movable ray intercepting diaphragm. Another object is to provide an improved plate holder with movable ray intercepting diaphragms upon opposite sides of the plate holder. Another object is to provide an improved combination of reversible table and plate holder adjustable thereon. Another object is to provide improved means to adjust and lock the reversible table and plate holder. Another object is to provide improved means to feed the "Buckey" diaphragm or diaphragms with reference to the sensitive plate. Another object is to provide improved means to time and feed the "Buckey" diaphragm and to energize the X-ray tube in synchronism. Another object is to provide improved means whereby the rate of feed of the diaphragm may be selectively varied. Another object is to provide improved means to set, feed, and release the diaphragm. My invention also comprises certain details of form and combination and arrangement of components, all of which will be fully set forth in the description of the accompanying drawings, in which:

Fig. 1 is a perspective view of an X-ray tube and photographic table embodying my invention.

Fig. 2 is a plan of the apparatus shown in Fig. 1.

Fig. 3 is an enlarged sectional detail of means employed to lock the table to its adjusted positions and to release it therefrom.

Fig. 4 is a sectional detail of latch mechanism employed to latch the diaphragm and plate holder to the standard carrying the X-ray tube to cause the plate holder and diaphragm to travel lengthwise of the table with the X-ray tube.

Fig. 5 is a plan of my improved diaphragm and plate holding apparatus detached from the table.

Fig. 6 is an end view of the same.

Fig. 7 is a front elevation of Fig. 5.

Fig. 8 is a perspective view of the apparatus employed to latch and release the diaphragms, and to synchronize the movements of the diaphragms with the development of X-rays in the tube.

Fig. 8[a] is a sectional detail of the feed speed controlling mechanism.

Fig. 9 is a wiring diagram showing the electrical connections for synchronously releasing the diaphragms and passing a current through the X-ray tube.

Fig. 10 is an enlarged sectional detail of a portion of the latching and releasing means shown in Fig. 8.

Fig. 11 is a sectional detail showing the means employed to adjustably mount the plate holder and diaphragms with reference to the reversible table.

Fig. 12 is a perspective view of a feed reversing cam employed to control the movements of the diaphragms.

Fig. 13 is a diagram illustrating the normal use of an X-ray tube, a subject to be photographed, and a plate holder and using the curved diaphragm.

Fig. 14 is a view similar to Fig. 13 showing the normal use of a plane diaphragm.

Fig. 15 is a diagram illustrating one position of adjustment of the tube, and plate holder in which the plate holder is vertically beneath the tube center.

Fig. 16 is a diagram similar to Fig. 15

illustrating relatively different positions of adjustment of the tube and plate holder, employed for instance to secure a photograph of an internal organ which if taken in position Fig. 15 would be in line with a bone or other opaque object.

The accompanying drawings illustrate the preferred embodiments of my invention in which 15 represents a rectangular metal table frame having journal boxes 16 at opposite ends in which are journaled trunnions 17 upon which the table or table top 18 is rotatably mounted so as to be reversibly adjusted relative to said frame.

A pin or stop roller 19 engages the frame 15 at opposite limits of the adjustment of the table top, and latch pins 20 projecting through longitudinal slots in the side of a tubular frame member 21 serve to engage recesses 22 in one or other of the forked brackets 23 carried by and at opposite sides of the table top to rigidly lock the table top to the frame 15 at opposite limits of the table top adjustment. The latch pins 20 are carried by sleeve members 24, see Fig. 3, which are rigidly mounted upon a rod 25 extending through the tube 21 and provided at opposite ends with disks or knobs 26. Springs 27 coiled about opposite ends of the rod 25 serve to resiliently hold the pins 20 in the slots 22. It will be found convenient for an operator wishing to reverse the position of the table to press his leg against the knob 26 at either end of the table and with both hands free to turn the table top over, and upon releasing pressure on the knob, the table top will be automatically latched in position. The faces of the brackets 23 are beveled so as to also serve to throw the latch pins 20 to one side as the table is reversed should pressure on the knob 26 be released before the pins 20 have entered the recesses 22.

A vertical tubular column or standard 28 is mounted by means of a series of rollers 30 to travel endwise along the tubular sections 21 and 29 of the table frame. Above the table is a horizontal bracket or frame 31, mounted by means of rollers 32 to travel vertically upon the column 28. The weight of the frame 31 is counterbalanced by means of a weight traveling up and down within the column 28 and connected by means of a chain 33 passing over a pulley 34 with the frame 31. An X-ray tube 340 is adjustably mounted upon the frame 31 to travel thereon to and from the column 28. The X-ray tube is also adjustably mounted upon the frame 31 or relative to the column 28 so as to have a substantially universal adjustment relative to the frame 31 or column 28 to enable the tube to be inclined to various degrees, and at a variety of positions or directions of inclination, to enable the X-rays to be directed therefrom toward the table in substantially any desired direction, as for instance to direct the X-rays upon any desired internal organ and to avoid interposing bones or other more opaque objects in the path of the rays to thereby obscure the photographic image. Independent locking members are provided to lock the column 28 to its adjusted position upon the table frame, to lock the frame 31 to its adjusted position upon the column 28, and to lock the X-ray tube to its adjusted position upon the frame 31.

The table top has a channeled face 35 and a plane face 36 spaced apart a sufficient distance for the plate holder and diaphragm apparatus to be interposed between said respective table faces, and to be adjusted therein endwise of the table either in conjunction with the column 28 and X-ray tube carried thereby or independently of said column and tube. The material of which the table faces 35 and 36 are constructed is pervious to X-rays, to enable sensitive plates carried in the plate holder between the table faces 35 and 36 to be exposed to the influence of X-rays passing from the X-ray tube through the subject to be photographed when supported upon the table top, through the table top face, through one of the diaphragms and through the face of the plate holder to the sensitive plate therein.

The diaphragms and plate holder apparatus comprise a supporting frame 37 which is supported within a recess between the two faces 35 and 36 of the table top, preferably by means of a series of rollers 38 engaging opposite sides of a pair of guide rods 39 carried by and at opposite sides of the table top whereby the frame 37 is movable to various positions of adjustment longitudinally of the table. Guide channels 40 and 41 are provided centrally within the frame 37 to receive and guide a photographic plate holder into a central position within frame 37. On one side of the plate holder within the frame 37 is mounted a curved diaphragm 42 fitted closely to the inner side of the curved table face 35, and curved substantially to the arc of a circle with the target of the X-ray tube as a center. On the opposite side of the plate holder within the frame 37 is another diaphragm 43 having a plane face and closely fitted to the inner side of the table face 36. The respective diaphragms are composed of alternate relatively narrow strips of material which are respectively pervious and impervious to X-rays and are designed to intercept stray rays, that is rays which are not traveling in nearly parallel directions, and to thereby facilitate the production of more sharply defined shadowgraphs than would be otherwise obtainable. In order to prevent the diaphragms from producing a ribbed effect

upon the sensitive plates, said diaphragms are kept in motion transversely across the face of the sensitive plates, during the period of exposure of the plates to the X-rays.

In order to move the diaphragms 42 and 43 they are connected together so as to move in unison. The curved diaphragm is guided at opposite sides thereof by means of rollers 440 traveling in curved slots 44 carried by the frame 37. The diaphragm 43 is similarly supported by roller 450 traveling in straight guides 45 carried by the frame 37. Energy to move the diaphragms relative to the frame 37 and the plate holder carried thereby is provided by means of a shaft 46 mounted in a stationary tubular barrel 47 and connected to said barrel by means of a coiled spring 470 attached at one end to the shaft 46 and at its opposite end to the barrel 47. The shaft 46 is journaled at opposite ends to the frame 37, and is provided with a cam 48 at one end, to which cam one end of a steel ribbon 49 is attached. The opposite end of the ribbon 49 is attached to the face of a pulley segment 50 which is mounted rigidly upon a shaft 51. One end of the shaft 51 is journaled to the frame 37, while the opposite end thereof is journaled in the end walls of a chambered member 52 which contains a body of liquid and is provided with a stationarily mounted gate or partition 53, and with a movable vane or wing 54 mounted rigidly upon the shaft 51 to rotate therewith within the cylindrical chamber of member 52. The gate or partition 53 has a port 55 controlled by a ball valve 56, which allows the fluid in the chamber to flow in one direction only through port 55 from one side to the other of the gate 53. A port 57 through the gate 53 is variably controlled by the adjustment of a manually operable valve 58 to permit a relatively slow or rapid flow of the fluid from one side to the other of the gate 53 in a direction opposite to the flow through the port 55. The barrel 47 may be manually rotated to put any desired tension through the spring 470 upon the shaft 46. A pawl 59 attached to the frame 37 engages a ratchet wheel 60 on one end of the barrel 47 to hold said barrel to its adjusted positions. The liquid in the chambered member 52 is driven by the vane 54 alternately in opposite directions toward the gate 53 as the shaft 51 is rotated in opposite directions. In one direction, that is to reset the diaphragms in position to be fed forward, the liquid flows freely through the port 55 allowing the diaphragms to be quickly returned to operative position, and latched ready to be released to feed forward. When the shaft 51 rotates in the opposite direction to feed the diaphragms for a radiographic exposure, the liquid of chambered member 52 flows through the port 57, which may be restricted by the valve 58 to any desired extent to thereby reliably and uniformly regulate the speed or rate of feed of the diaphragms across the face of the plates, depending upon the time of the exposure to be given to the plate.

The segment 50 is provided with a projection 62 adapted to be engaged by a pin or stud 63 carried at the end of a crank arm 64 mounted upon the end of a shaft 65. The stud 63 is adapted to be disengaged from the projection 62 to allow the diaphragms to feed forward either by rocking the shaft 65 so as to free the stud 63 from projection 62, or by shifting the shaft 65, crank arm 64, and stud 63 endwise of shaft 65 to free the stud 63 from the projection 62. To manually release the stud 63 from the projection 62 I preferably employ a spring actuated plunger 66 to normally engage the crank arm 64 and prevent a disengagement of the stud 63, and a ball 67 and chain 68 to be manually operated to retract the plunger 66 against the action of the spring 69.

Where it is desired to release the stud 63 from the projection 62 by electrically actuated means in synchronism with the application of energy to the X-ray tube, I provide an electro-magnet or solenoid 70 having a pull rod 71 which has an annular recess 72 to be engaged by the periphery of a disk 73 mounted upon the end of shaft 65 whereby when the solenoid 70 is energized electrically the pull rod 71 pulls the shaft 65 endwise toward the solenoid 70 against the action of a spring 74 coiled upon and tending to force the shaft 65 away from the solenoid 70. The endwise movement of shaft 65 carries with it the crank 64 and stud 63, thereby releasing the stop 62 from the stud 63 and allowing the segment 50 and shaft 51 to rotate at the predetermined rate of speed prescribed by the adjustment of the valve 58 and port 57, and allowing the shaft 46 and spring 470 to feed the diaphragms forward across opposite faces of the plate holder at the prescribed rate of speed. The stem of the valve 58 is provided with a pointer 76 which moves over the face of a scale 77 on the face of frame 37 and thereby enables the operator to set the valve 58 to provide for any desired rate of travel of the diaphragms.

It is desirable that the movement of the diaphragms and the application of energy to the X-ray tube be synchronized so that by the closing of an electrical circuit the diaphragms will first be released and commence their movement relative to the plate holder, at a predetermined rate of speed depending upon the nature of the photograph to be taken and the length of exposure to be given, then that current shall be applied to the X-ray tube for the predetermined

length of time considered requisite for the exposure, and then the current cut off from the X-ray tube, and later that the forward feed of the diaphragms be automatically stopped and the energizing circuit opened, and finally that the diaphragms and their feeding apparatus may be reset or returned to their original position without applying energy to the X-ray tube.

In order to accomplish these features in synchronism I provide an electrical three wire circuit substantially as shown in Fig. 9 having for instance two positive branches 78 and 79, and a negative or return line 80. A push button 81 located at any position in the circuit convenient to the operator, enables the circuit to be closed when conditions are suitable for taking the photograph, to thereby initiate the sequence of movements and stops heretofore outlined. The closing of the circuit at the push button 81, serves to energize the solenoid 70, to move the shaft 65 endwise thereby retracting the latch member starting the forward feed of the diaphragms, which also causes the shaft 51 to rotate. The shaft 51 carries a switch blade 82 which is in engagement between two electrical contacts 83 and 84. After the latch 63 has been released blade 82 rotates to open circuit 78. When shaft 51 commences to rotate it thereby furnishes means for later closing the circuit 79 and electrically actuating a switch 840 to close the primary electrical circuit 85 of a high tension transformer, the secondary 86 of which furnishes electrical energy to the X-ray tube 340 so long as the switch blade 89 continues to close the circuit 79 at the contact points 91 and 92. During the period while circuit 78 has been closed at the points 83 and 84 by the blade 82, and subsequent to the closing of the circuit at push button 81, a cam 87 also mounted rigidly upon and rotatable with the shaft 51 moves into position to engage a stud 88 projecting from an endwise movable switch member 89 which is resiliently energized by a coiled spring 890 in opposed relation to a coiled spring 891 to normally hold the member 88 in the path of the cam 87 and the member 89 out of engagement with the electrical contacts 91 and 92 interposed in the electrical circuit 79.

As the shaft 51 rotates the cam 87 compresses spring 890 and throws the switch member 89 into engagement with the contacts 91 and 92 thereby closing the circuit 79, which occurs for instance after the diaphragms have made approximately one-fifth of their movement. Closing of the circuit 79 serves to electrically energize the switch 840, which in turn closes the primary circuit 85, and energizes the X-ray tube. The period during which the X-ray tube is energized covers for instance approximately three-fifths of the period of movement of the diaphragms, leaving the diaphragms still in movement for approximately one-fifth of their period of movement after the circuits 79 and 85 have been opened and the X-ray tube deenergized. The circuit 79 is opened due to the cam 87 passing out of engagement with the stud 88 allowing the spring 890 to retract the switch member 89 from the contacts 91 and 92. Opening of circuit 79 releases the electrically controlled switch 840 to thereby break the primary circuit 85. The rotation of shaft 51 also shifts switch lever 82 out of engagement with contacts 83 and 84 releasing the shaft 65 from the pull of the solenoid 70 and allowing the latch member 63 to move endwise into position to again engage the stop or projection 62 of the segment 50.

When the diaphragms have reached the limit of their movement relative to their supporting frame and travel guides 44 and 45 thereon, the diaphragms come to a rest, and require to be reset to become again operative. This resetting operation is effected by manually rotating the shaft 51 in a reverse direction by means of a hand lever 94 attached to the shaft 51 outside of the frame 37. Movement of the shaft 51 in reverse direction to reset the diaphragms causes the fluid in the chambered member 52 to flow freely past the ball 56 through port 55 ahead of the vane 54. At the same time the stud 88 which normally stands in the path of the cam 87 is engaged by the inclined edge 95 of said cam to thrust the stud 88 in a reverse direction to that of the forward feed of said cam, thereby preventing the circuit 79 being closed at the contacts 91 and 92, and thus preventing the X-ray tube being energized on the reverse or resetting movement of the shaft 51. As soon as the stop 62 of segment 50 reaches and engages the latch member 63, the diaphragms are reset in operative position ready to repeat the cycle of movement heretofore described.

I preferably provide an alarm bell or similar member 97, the hammer 98 of which is adapted to be tripped by a stud 99 carried by and rotatable with the shaft 51 to indicate to the operator when the diaphragms have reached the limit of their movement, and are ready to be reset.

Where for instance it is desirable to secure a comprehensive radiograph of the whole or major portion of the chest or abdomen, corresponding to a view in ordinary photography with a wide angle lens it is preferable to support the subject 101 upon the channeled face 35 of the table and make the exposure upon a relatively large sensitive plate through the channeled diaphragm 42 as indicated diagrammatically in Fig. 13. Where, however, it is desired to photograph a single organ 103 or restricted portion of the chest or abdomen, for instance, it is

preferable to support the subject to be radiographed upon the plane table face 36 and make the exposure through the plane faced diaphragm 43 upon a relatively small sensitive plate as indicated in Fig. 14. In Fig. 15 I have illustrated diagrammatically one adjustment of the subject 101 upon the table face and above a sensitive plate 102 in order that an organ 103, for instance may be radiographed to obtain a plate full of detail without interference by reason of adjacently positioned bones or other dense or nearly opaque objects 104. In Fig. 15 I have illustrated diagrammatically another relative adjustment of the X-ray tube, the subject 101, and the plate holder and diaphragm, somewhat similar to that shown in Fig. 15, illustrating the range of adjustment of said members for obtaining similar results to those above specified for Fig. 15.

The apparatus illustrated particularly in Fig. 8[a] for regulating the rate of movement of the diaphragms avoids any sudden jump or vibration of the diaphragms when the latch members 62 and 63 are released, and causes the diaphragms to commence movement without vibration; to quickly reach maximum rate of speed and thereafter to maintain a uniform rate of speed until the diaphragms reach the limit of their movements, at which time the exposure has been fully completed, and any vibration in stopping the diaphragm movement is not liable to affect the image on the sensitive plate. It will be noted that the length of exposure of the sensitive plate to X-rays depends upon the period of time taken by the cam 87 to pass the stud 88, and that as the cam 87 is carried by the shaft 51, regulation of the valve 58 the position of which is accurately shown by the pointer 76 on a scale 77, enables the operator to regulate the speed of the diaphragms and the length of exposure of the sensitive plate at one operation by adjustment of said valve 58, and that the period of exposure of the plate may be predetermined and read directly from the scale 77. The respective diaphragms are jointly attached by means of a clamping member 106 to the metal tape or strap 49.

In Fig. 4 I have illustrated a latch member 107 seated in a socket 108 attached to the diaphragm frame 37, a coiled spring 109 serves to energize said latch member to latch the diaphragm frame 37 to the column 28, to cause the frame 37 when desired to move endwise of the table with the column 28 and X-ray tube carried by column 28. In order that the frame 37 may be latched with reference to the column 28 in a plurality of positions, as for instance with the sensitive plate directly beneath the X-ray tube as indicated in Fig. 15, or either to the right hand or to the left hand thereof as indicated in Fig. 16, I provide a plurality of latch engaging sockets 112 mounted and adjustable upon a bar 114 carried by the column 28, whereby the latch member 107 may enter selectively any one of the sockets 112 for the above variety of adjustments. The latch member 107 is also provided with a lateral stud 116 adapted to enter an L-shaped slot 117 in the wall of the socket 108 to lock the latch member 107 in retracted position out of engagement with the sockets 112 when it is desired to disengage the frame 37 from the column 28 and independently adjust the frame 37 by hand along the table.

The apparatus herein shown and described is capable of considerable modification within the scope of the claims without departing from the spirit of my invention.

What I claim is:

1. In combination with an X-ray generator, a table frame, a table top reversibly mounted thereon and provided with a substantially plane table face and a channeled table face to be selectively employed to support subjects to be radiographed with reference to said generator, a plate holder carriage mounted intermediate of said table faces and provided with a substantially plane movable diaphragm and a channeled movable diaphragm and an interposed sensitive plate holder.

2. In combination with an X-ray generator, a table frame, a table top reversibly mounted thereon and provided with a substantially plane table face and a channeled table face to be selectively employed to support subjects to be radiographed with reference to said generator, said generator and table top being relatively adjustable lengthwise of said table top, a plate holder carriage mounted intermediate of said table faces and adjustable endwise relative to said table top, said carriage being provided with a substantially plane movable diaphragm and a channeled movable diaphragm and an interposed sensitive plate holder.

3. In combination with an X-ray generator, a table frame, a table top reversibly mounted thereon and provided with a substantially plane table face pervious to X-rays and a channeled table face pervious to X-rays, a resiliently energized latch bar provided with a latch member and adapted to be energized by pressure on the end of said latch bar to release the latch carried thereby from interengaging latch members carried at opposite sides of said table top.

4. In combination with an X-ray generator, a table frame, a table top reversibly mounted thereon and provided with a substantially plane face pervious to X-rays, and a channeled face pervious to X-rays, said table top and generator being relatively adjustable lengthwise of said table, a sensitive plate holder interposed between said table faces, and latch mechanism to posi-

tively latch said table top to its adjusted positions relative to its supporting frame.

5. In combination with an X-ray generator, a table frame, a table top reversibly mounted thereon and provided with a substantially plane face pervious to X-rays and a channeled face pervious to X-rays, said table top and generator being relatively adjustable lengthwise of said table, a plane diaphragm mounted to move across the inner side of said plane table face, a channeled diaphragm mounted to move across the inner side of said channeled table face, a sensitive plate holder mounted intermediate of said table faces and said diaphragm and latch mechanism to positively latch said table top to its adjusted positions relative to its supporting frame.

6. In combination with an X-ray generator, a table frame, a table top reversibly mounted thereon and provided with a substantially plane face pervious to X-rays and a channeled face pervious to X-rays, said table top and generator being relatively adjustable lengthwise of said table, a plate holder carriage interposed between said table faces and adjustable endwise of said table top, a sensitive plate holder detachably mounted upon said plate holder carriage, means to selectively latch said plate holder carriage to said generator to cause said generator and plate holder carriage to travel in unison lengthwise of said table top, and latch mechanism to positively latch said table top to substantially opposite limits of its adjustment relative to its supporting frame.

7. In combination with an X-ray generator, a table frame, a table top reversibly mounted thereon and provided with a substantially plane face pervious to X-rays and a channeled face pervious to X-rays, said table top and generator being relatively adjustable lengthwise of said table, a plate holder carriage provided with a plane diaphragm mounted to move adjacent to said plane table face and a channeled diaphragm mounted to move relatively to said channeled table face, and adjustable endwise of said table top, a sensitive plate holder detachably mounted upon said carriage intermediate of said diaphragms, means to selectively latch said carriage to said generator to cause said generator and carriage to travel in unison lengthwise of said table, and latch mechanism to positively latch said table top at substantially opposite limits of its adjustment to its supporting frame.

8. In combination with an X-ray generator an electric circuit to energize said generator, a plate holder supporting frame having a recess to detachably receive a plate holder, a diaphragm movably mounted upon said frame at one side of said plate holder to be interposed between the plate holder and a subject to be radiographed, means to drive said diaphragm across the face of the plate holder covering the period of exposure of the plate, a latch to set and release said diaphragm, a member to open and close the primary of said generator energizing circuit, a synchronizing electric circuit having a circuit closing switch and a circuit breaking switch, and partly controlled in unison with the movements of said diaphragm, said synchronizing circuit serving successively to unlatch and initiate movement of said diaphragm, to close the generator primary and excite the X-ray generator, to break the generator primary and deenergize the X-ray generator before movement of the diaphragm has ceased.

9. In combination with an X-ray generator an electric circuit to energize said generator, a plate holder supporting frame having a recess to detachably receive a plate holder, a pair of diaphragms movably mounted upon said frame at opposite sides of said plate holder respectively to be interposed between the plate holder and a subject to be radiographed, means to drive said diaphragms across the face of the plate holder covering the period of exposure of the plate, a latch to set and release said diaphragm, a member to open and close the primary of said generator energizing circuit, a synchronizing electric circuit having a circuit closing switch and a circuit breaking switch, and partly controlled in unison with the movements of said diaphragm, said synchronizing circuit serving successively to unlatch and initiate movement of said diaphragm, to close the generator primary and excite the X-ray generator, to break the generator primary and deenergize the X-ray generator before movement of the diaphragm has ceased.

10. In combination with an X-ray generator, a plate holder supporting frame, a plate holder detachably supported by said frame, a diaphragm movably mounted upon said frame to be interposed between said plate holder and a subject to be radiographed, means to drive said diaphragm across the face of the plate holder, a member movable in unison with the movements of said diaphragm armed with a releasing latch member to release said diaphragm and allow the diaphragm to move across the face of the plate holder covering the period of the radiographic exposure, means operable by said movable latch member to close an X-ray tube energizing circuit after the commencement of movement of said diaphragm and to open said X-ray tube energizing circuit before movement of said diaphragm stops, means to control the rate of movement of said movable latch carrying member, and a latch member operable to release said movable latch carrying member

and its latch to initiate movement of said diaphragm.

11. Radiographic apparatus comprising an X-ray generator, a reversible support for a subject to be radiographed having a channeled face pervious to X-rays and a substantially plane face pervious to X-rays, a sensitive plate interposed between said pervious supporting faces, a channeled diaphragm interposed between said sensitive plate and said channeled pervious supporting face and adjustably mounted to move transversely across the face of said sensitive plate, a substantially plane diaphragm interposed between the sensitive plate and said plane supporting face and adjustably mounted to move transversely across the face of said sensitive plate, and means to feed said diaphragms across the face of said sensitive plate.

12. Radiographic apparatus comprising an X-ray generator, a support for a subject to be radiographed pervious to X-rays, a sensitive plate located at the opposite side of said support from said X-ray generator, a diaphragm interposed between said support and said sensitive plate and adjustably mounted to move transversely across the face of said sensitive plate, a member under tension adapted to feed said diaphragm under substantially uniform tension across said sensitive plate, a shaft operatively connected to said diaphragm to rotate in unison with the movements of said diaphragm, a first latch member carried by said shaft, a second latch member operable to release said shaft and diaphragm, a chambered member in substantially axial alignment with said shaft and charged with a fluid body and into which said shaft projects, a stationary gate between said shaft and the wall of said chamber, a blade within said chambered member carried by and movable with said shaft to insure a substantially uniform rate of feed of said shaft and diaphragm, a valve manually operable to variably control the flow of a liquid in said chambered member and thereby the rate of movement of said shaft and diaphragm, and means to release said first latch member from said second latch member.

13. Radiographic apparatus comprising an X-ray generator, a support for a subject to be radiographed pervious to X-rays, a sensitive plate located at the opposite side of said support from said X-ray generator, a diaphragm interposed between said support and said sensitive plate and adjustably mounted to move transversely across the face of said sensitive plate, a member under tension adapted to feed said diaphragm under substantially uniform tension across said sensitive plate, a shaft operatively connected to said diaphragm to rotate in unison with the movements of said diaphragm, a first latch member carried by said shaft, a second latch member operable to release said shaft and diaphragm, a dash-pot operatively connected to said shaft to insure a substantially uniform rate of feed of said shaft and diaphragm, a valve manually operable to variably control the flow of a liquid in said dash-pot and thereby the rate of movement of said shaft and diaphragm, an electrical circuit having an electrically actuated switch operable to energize and de-energize said X-ray generator, a circuit closing member operable by said shaft to energize said X-ray generator through a fraction of the period of rotation of said shaft, and means to release said first latch member from said second latch member.

14. Radiagraphic apparatus comprising an X-ray generator, a support for a subject to be radiographed previous to X-rays, a sensitive plate located at the oposite side of said support from said X-ray generator, a diaphragm interposed between said support and said sensitive plate and adjustably mounted to move transversely across the face of said sensitive plate, means under tension to feed said diaphragm across said sensitive plate, a shaft operatively connected to said diaphragm to rotatably oscillate in unison with the movements of said diaphragm, a chambered member charged with a body of fluid and into which said shaft projects substantially axially thereof, a stationary gate extending radially between said shaft and the wall of said chambered member, a blade carried by said shaft and oscillatorily movable in said chambered member to alternately drive said fluid in opposite directions therein, a restricted fluid passage through said gate, a valve manually operable to variably control said restricted passage and vary the rate of feed of said diaphragm, a first latch member movable in unison with said diaphragm, a second latch member to engage said first latch member, and means to disengage said latch members and initiate a forward feed of said diaphragm and said shaft.

15. Radiographic apparatus comprising an X-ray generator, a support for a subject to be radiographed, a sensitive plate located at the opposite side of said support, a diaphragm interposed between said sensitive plate and the support and adjustably mounted to move transversely across the face of said sensitive plate, means under tension to feed said diaphragm across said sensitive plate, a shaft operatively connected to said diaphragm to rotate in unison with the movements of said diaphragm, a chambered member substantially concentric with said shaft and into which said shaft projects, said chambered member being charged with a substantially incompressible fluid, a stationary gate extending

radially from said shaft to the wall of said chamber, a restricted fluid passage through said gate, a blade carried by said shaft movable in said chambered member to drive said fluid through said restricted fluid passage, a valve manually operable to vary said restricted passage to thereby vary the rate of feed of said diaphragm, and latch members adapted to be disengaged to initiate a forward feed of said diaphragm and speed regulating shaft.

In testimony whereof I have hereunto affixed my signature.

JOHN ROBERT KELLEY.