

May 13, 1958

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Filed May 12, 1955

11 Sheets-Sheet 1

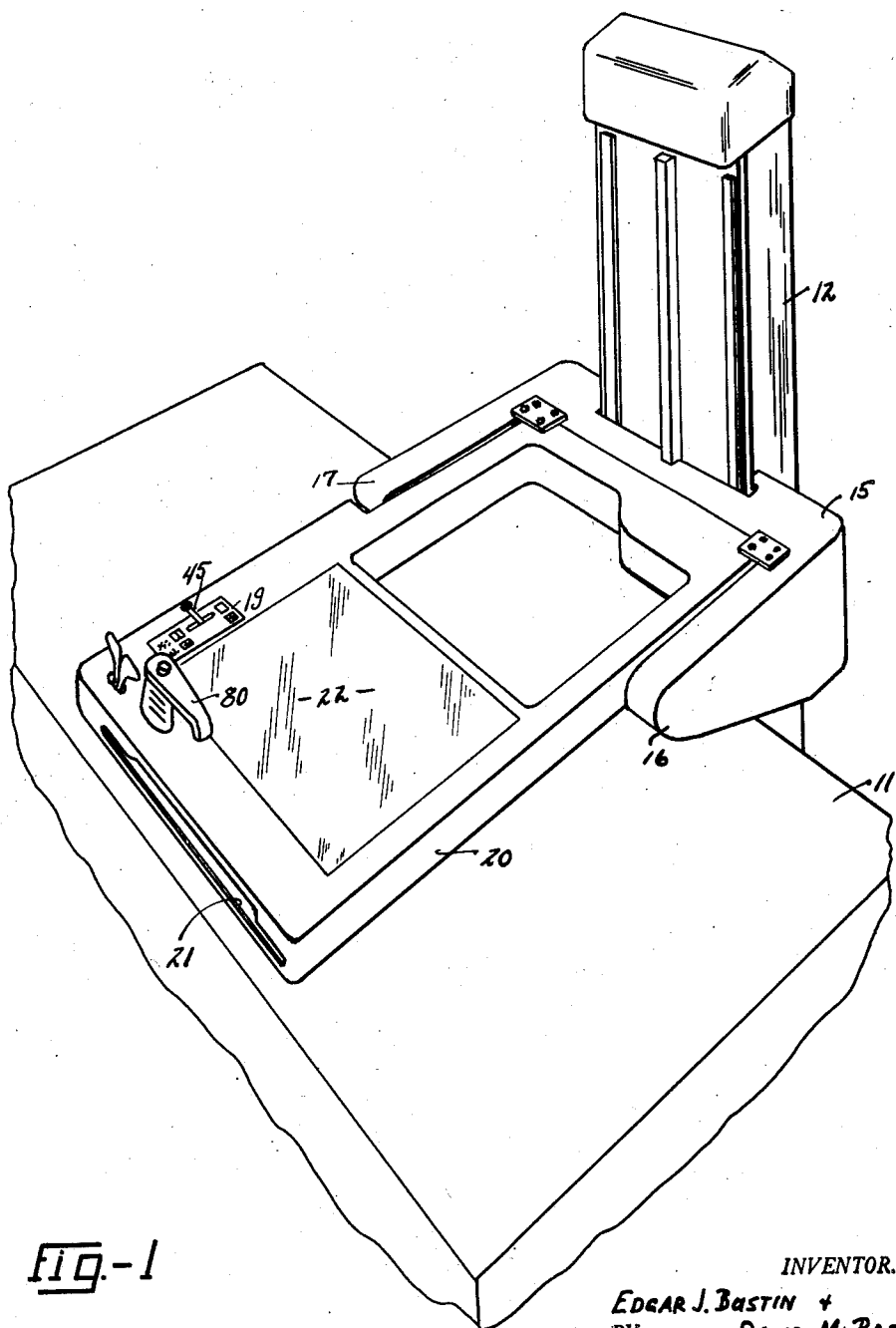


FIG.-1

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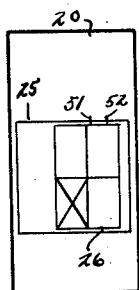


FIG.-2

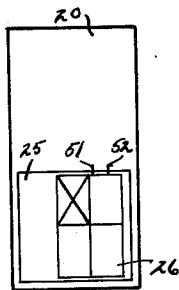


FIG.-3

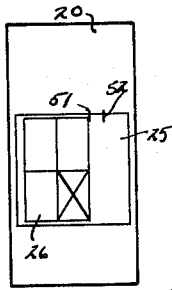


FIG.-4

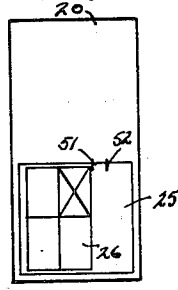


FIG.-5

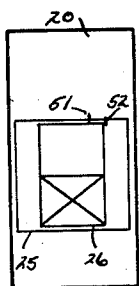


FIG.-6

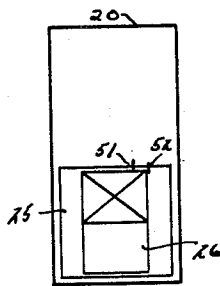


FIG.-7

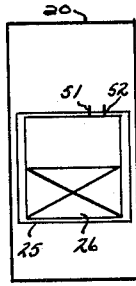


FIG.-8

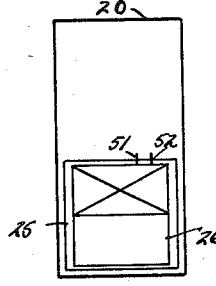


FIG.-9

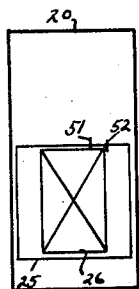


FIG.-10

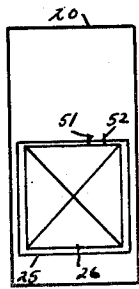


FIG.-11

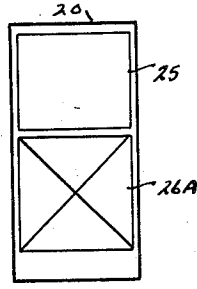


FIG.-12

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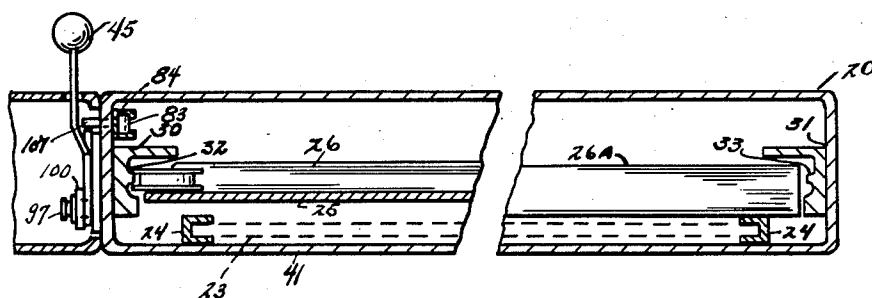
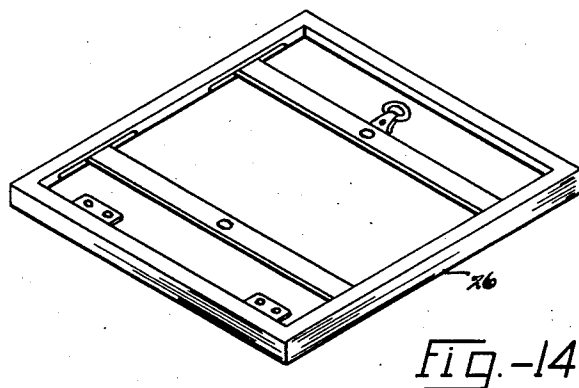
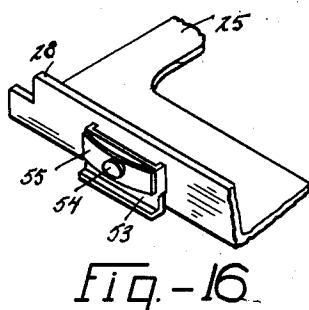
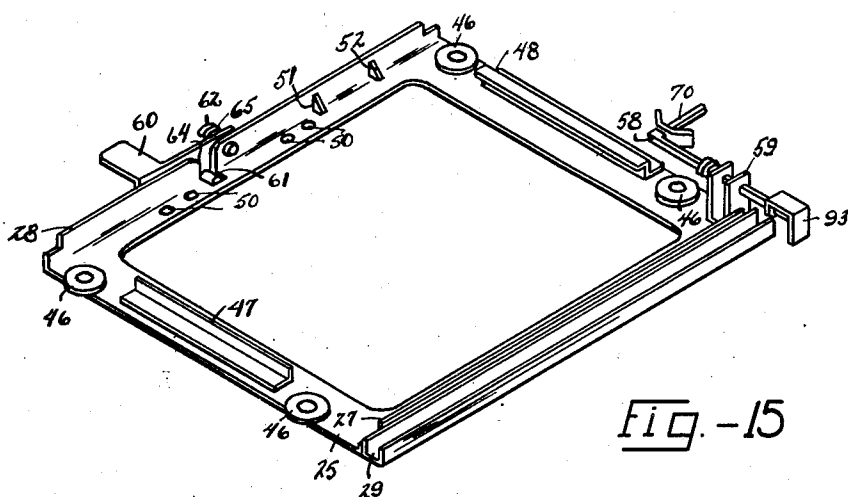
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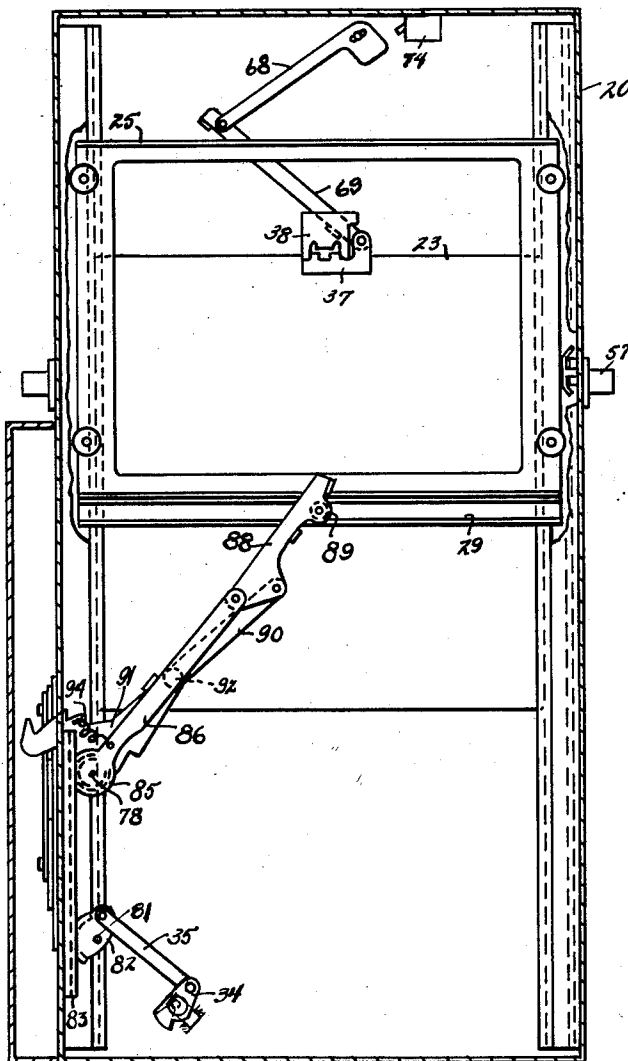


Fig. 17

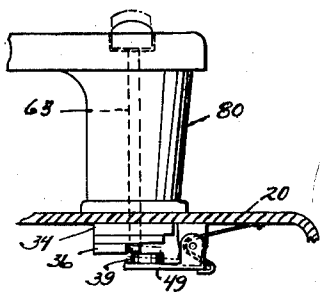


Fig. 18

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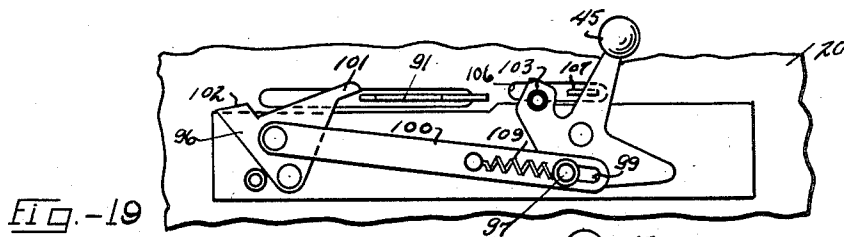
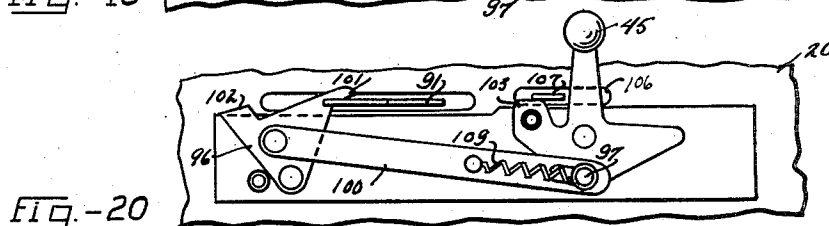
Fig. - 19

Fig.-20

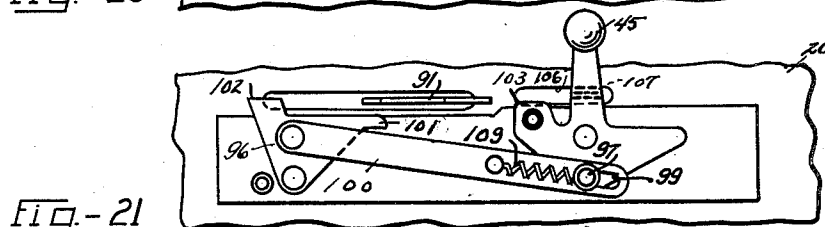


Fig.-21

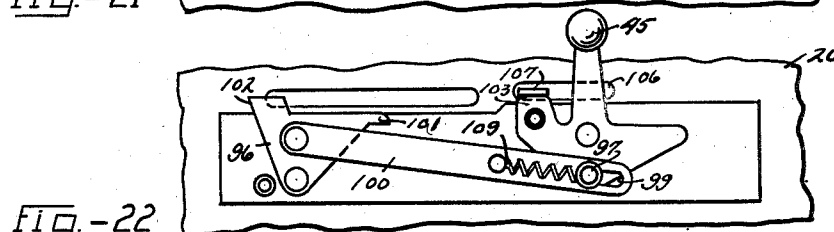


Fig.-22

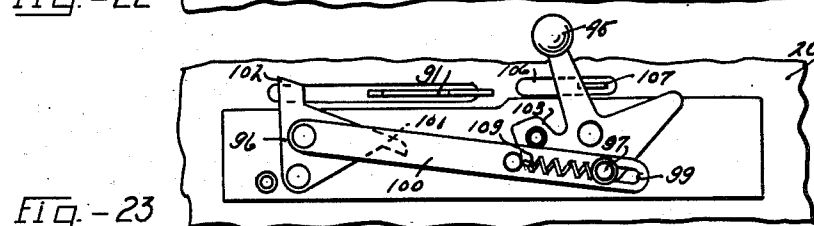


Fig. - 23

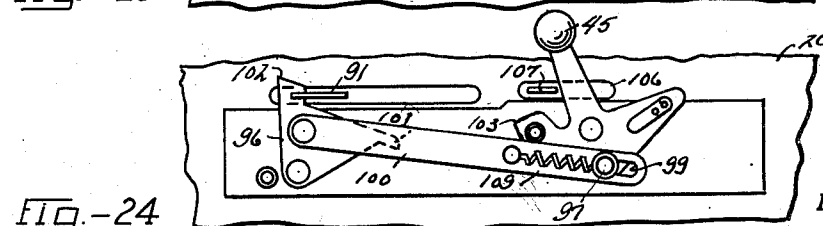


Fig.-24

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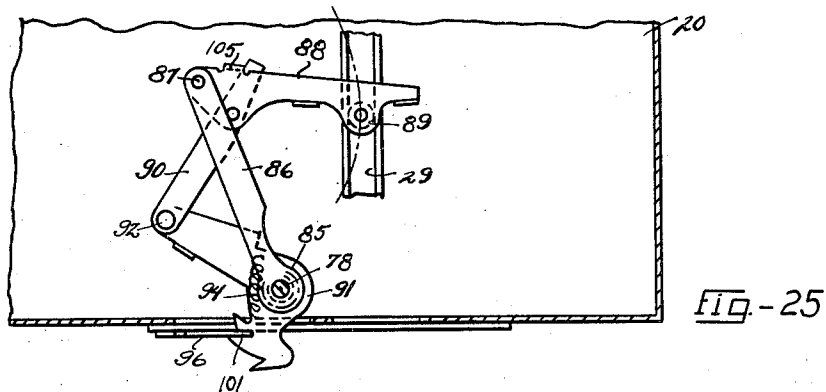


FIG. -25

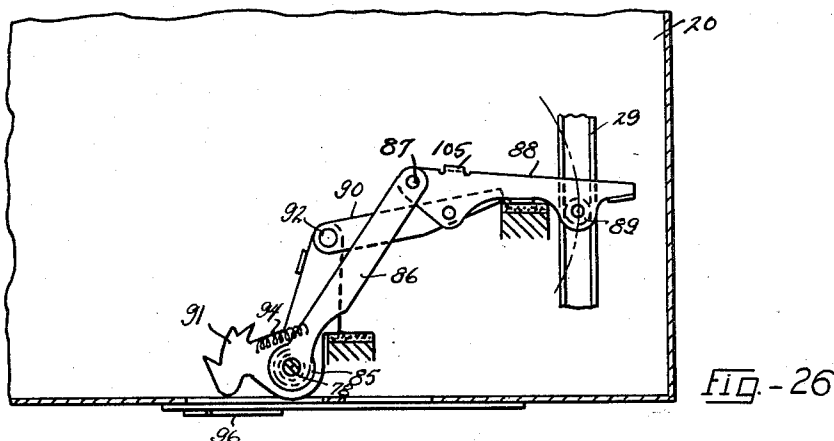


FIG. -26

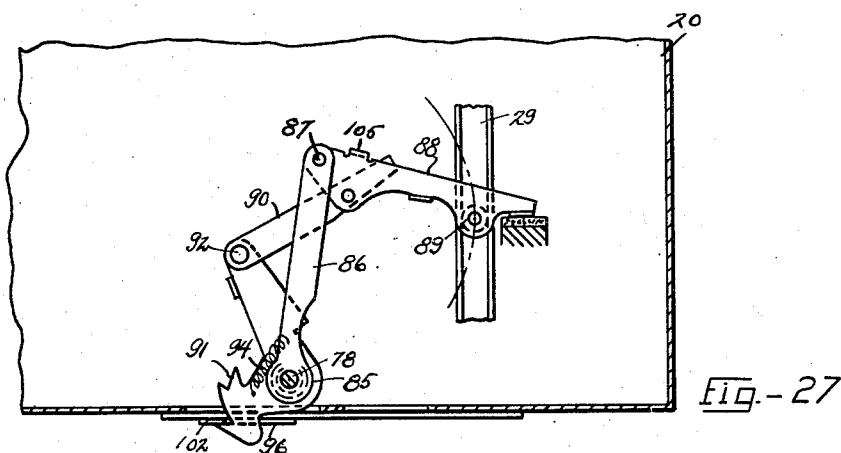


FIG. -27

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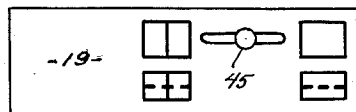
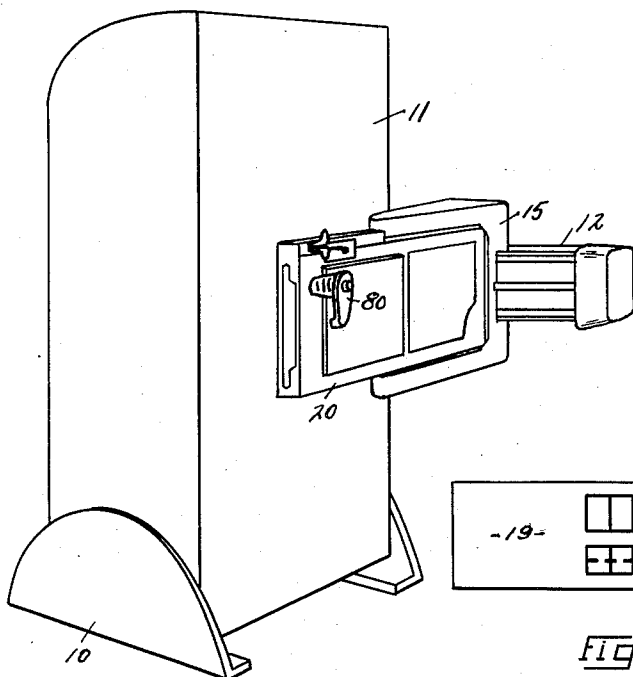


FIG. - 29

FIG. - 28

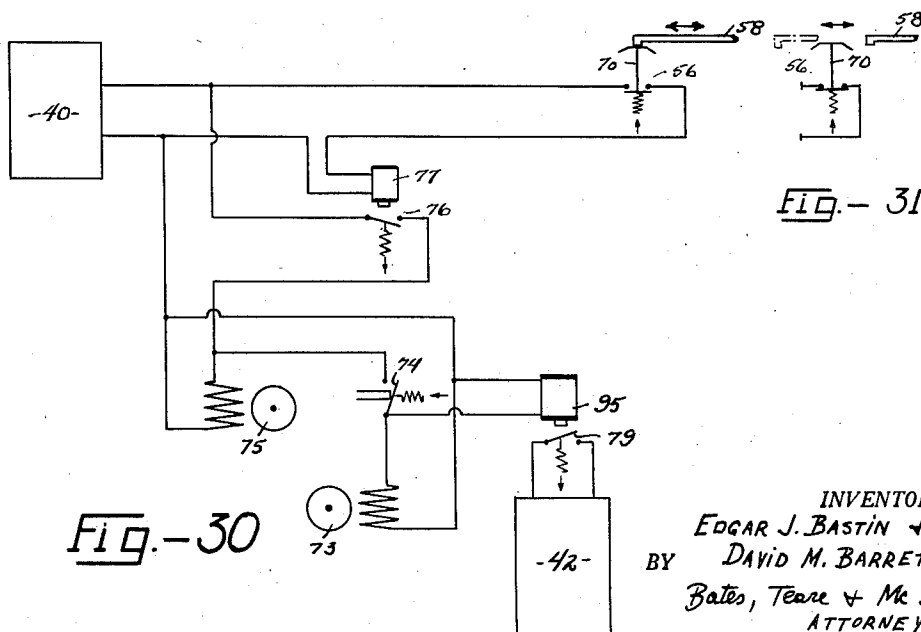


FIG. - 31

FIG. - 30

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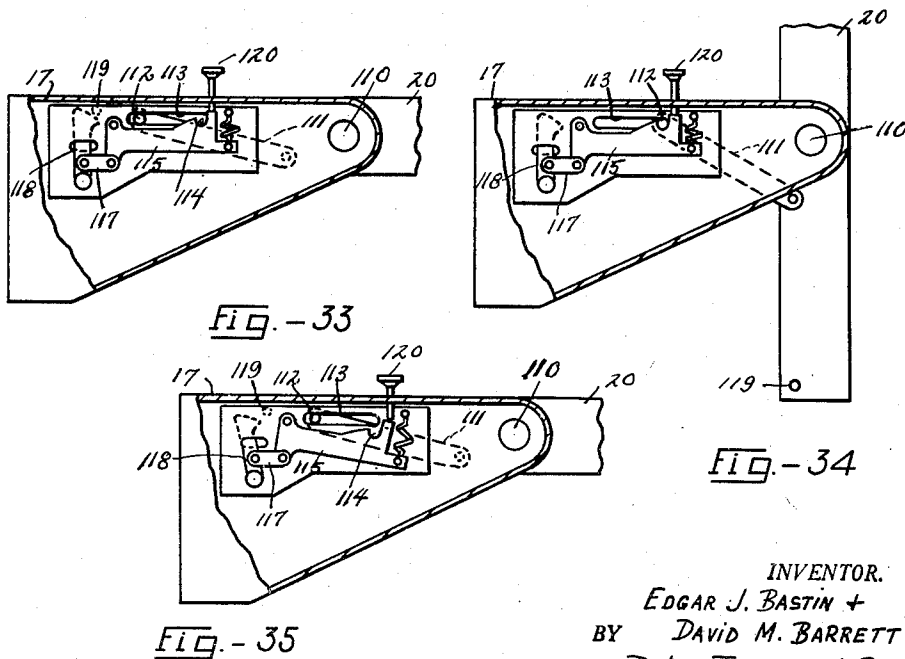
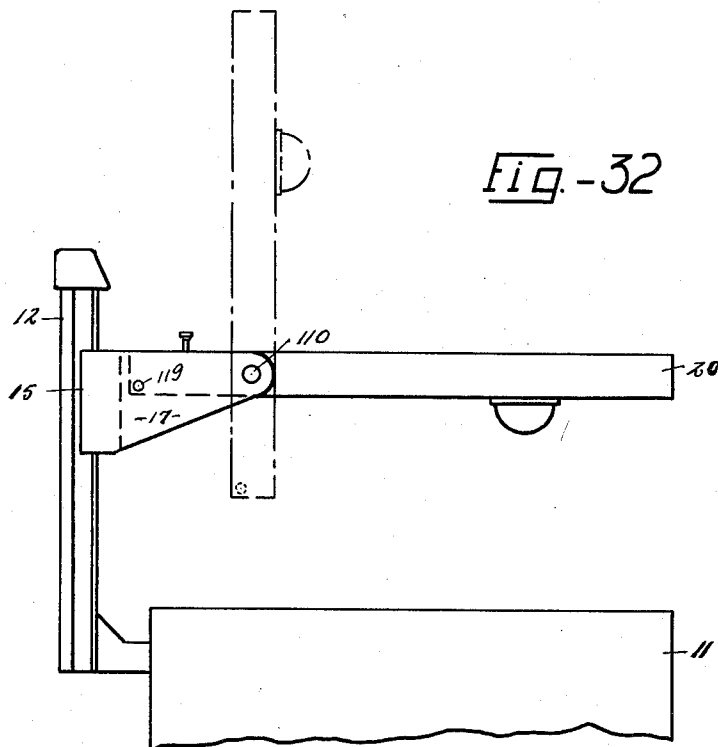
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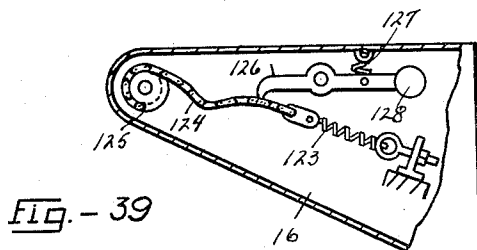
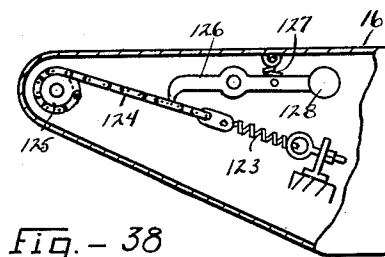
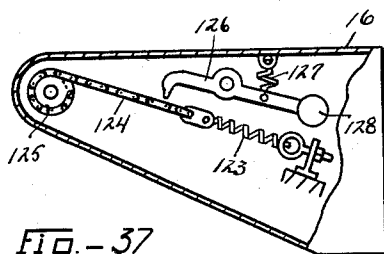
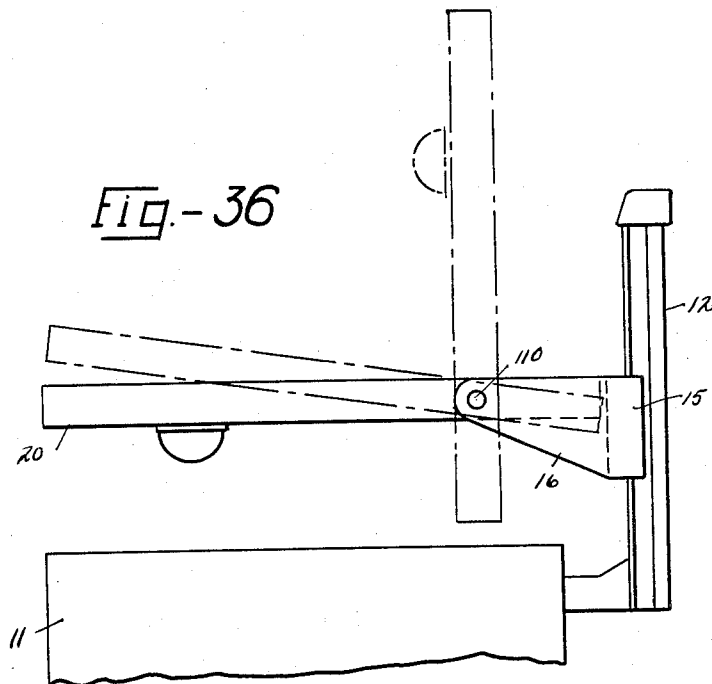
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11 Sheets-Sheet 9



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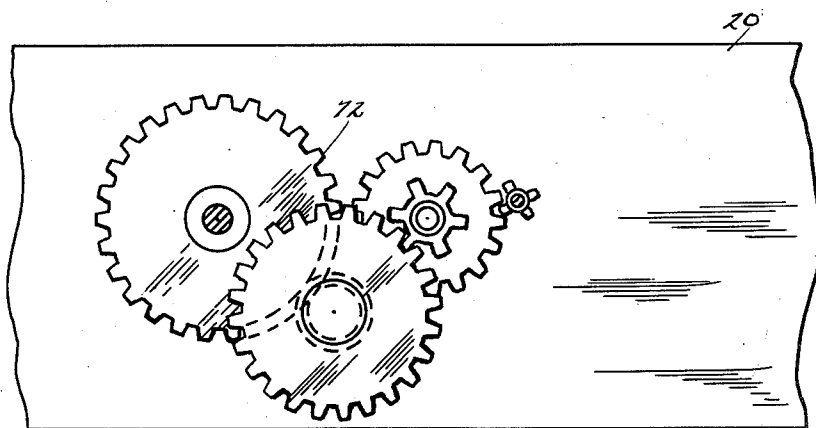
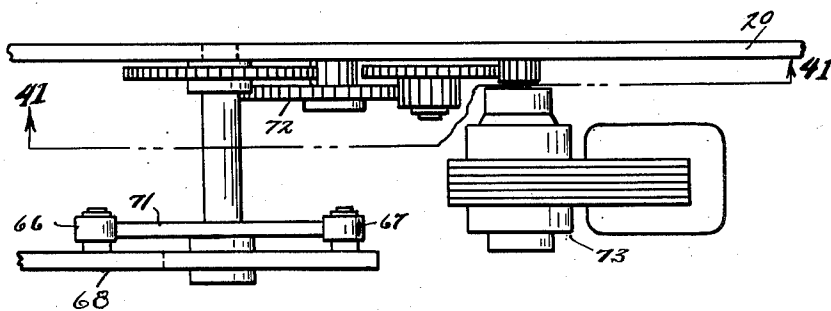
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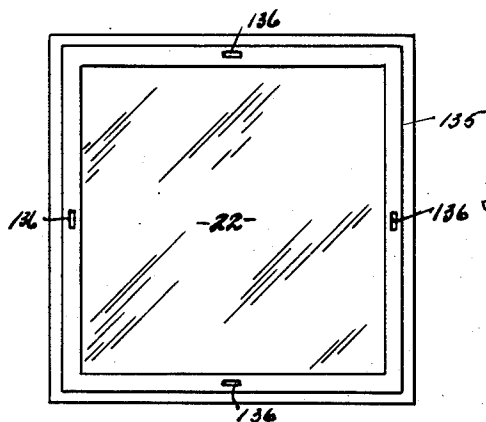


FIG. - 47

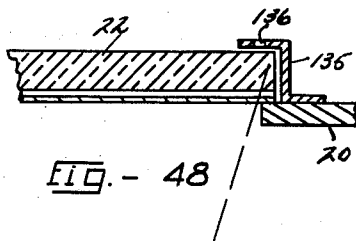


FIG. - 48

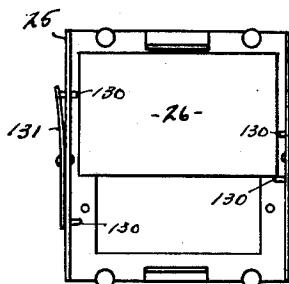


FIG. - 44

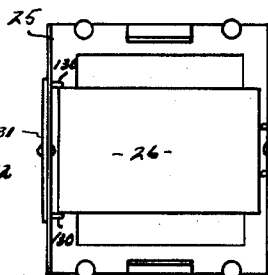


FIG. - 45

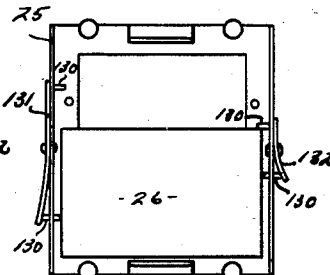


FIG. - 46

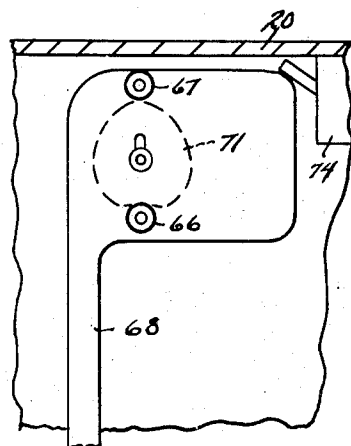


FIG. - 42

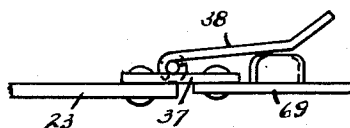


FIG. - 43

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Application May 12, 1955, Serial No. 507,846

28 Claims. (Cl. 250—66)

This invention relates generally to improvements in X-ray apparatus and more particularly relates to an arrangement for improving the technique of spot and serial radiography.

The X-ray apparatus to which this improved arrangement may be applied includes a spot film device adapted for fluoroscopy and radiography. The spot film device includes a film cassette carrier movably supported in a fluoroscopic screen housing which is in turn mounted for movement along a vertical column. In practice, the screen housing is positioned by an operator to scan an area for pathology and, whenever an area of which a record is desired is located, the operator holds the screen housing in a steady position and the film cassette is moved into the intended region for exposure.

This type of apparatus usually includes a mechanism for moving the film cassette from a storage position to a position of exposure. Heretofore, such mechanism has required some arrangement for checking or controlling the speed of the moving film cassette in an attempt to stop it near the area of exposure. Actually, any attempt to stop or check a moving film cassette can only result in haphazard positioning of the cassette in the exposure area because of uncontrollable rebound and vibration movements. Since proper alignment of the film cassette in each of the multiple exposure locations is essential, such haphazard cassette positioning is undesirable.

Accordingly, a principal object of this invention relates to the provision of an arrangement for accomplishing the positive alignment of a film cassette with any selected one of multiple X-ray exposure locations.

Another object of this invention relates to improvements in the automatic conditioning of an X-ray apparatus for radiography.

A further object of this invention relates to an improved arrangement for sequentially exposing different portions of an X-ray film.

These, and other objects, will become more readily apparent when reference is had to the accompanying drawing together with the following description and appended claims.

Briefly, in accordance with this invention, a film cassette may be selectively positioned into alignment with multiple X-ray exposure locations within a fluoroscopic screen housing for controlled sequential radiography. The positioning mechanism follows a simple harmonic motion having zero velocity at the selected location and includes a manually activated arrangement for conditioning the mechanism to vary the amplitude of its motion in accordance with the type of film exposure desired. Positioning of the film cassette for radiographic exposure automatically conditions the X-ray tube energizing circuits for radiography and also automatically activates a Bucky grid reciprocating mechanism and a photo-timing compensating circuit.

The apparatus of this invention also includes a device for releasably securing the fluoroscopic screen housing in fixed horizontal or vertical position relative to the patient

supporting table and a mechanism for counterbalancing vertical positioning of the fluoroscopic screen housing when the table is disposed horizontally. In addition, the invention contemplates a modification of the fluoroscopic screen housing to provide a warning indication to the operator when the X-ray beam angle exceeds the effective area of the fluoroscopic screen.

In the drawings:

Fig. 1 is a perspective view of an X-ray apparatus embodying the invention;

Figs. 2 through 5 inclusive diagrammatically illustrate various positions of film cassette and its carrier for exposure of quarter sections of the film;

Figs. 6 and 7 are diagrammatic illustrations of sequential positions of the film cassette and carrier for exposure of half sections of the film;

Figs. 8 and 9 are diagrammatic illustrations similar to Figs. 6 and 7 but with larger film;

Figs. 10, 11 and 12 diagrammatically illustrate film cassette and carrier positions for full exposure of various film sizes; Fig. 10 illustrating the cassette and carrier position with a small size film; Fig. 11 illustrating the cassette and carrier position with an intermediate size film; and Fig. 12 illustrating the cassette and carrier positions with a large size film;

Fig. 13 is a broken sectional view of the fluoroscope screen housing illustrating on the right, the position of the film cassette for the condition of Fig. 12 where the carrier is retained in storage, and illustrating on the left, the location of the cassette carrier in an exposure position;

Fig. 14 is a perspective view of the film cassette;

Fig. 15 is a perspective view of the film cassette carrier;

Fig. 16 is a partial perspective view of the cassette carrier illustrating particularly the cassette location stops;

Fig. 17 is a top sectional view of the fluoroscope housing illustrating the interior with the cassette carrier partially advanced;

Fig. 18 is a partial elevational view of the manual control mechanism in the fluoroscope housing for positioning the cassette carrier;

Figs. 19 through 24 are partial views of different conditions of the control mechanism for selecting the various cassette carrier positions shown in Figs. 2 through 12;

Figs. 25, 26 and 27 are partial views of different positions of the cassette carrier and its motivating mechanism;

Fig. 28 is a perspective view of the X-ray apparatus with the table in vertical position;

Fig. 29 is an enlarged view of an identification selector plate affixed on the fluoroscope housing;

Fig. 30 is a schematic circuit diagram illustrating the switch controlled changeover from fluoroscopic to radiographic operation of the X-ray tube;

Fig. 31 is a portion of the schematic diagram of Fig. 30 illustrating a different condition of the carrier controlled switch;

Fig. 32 is an end elevation view of the X-ray apparatus showing the vertical position of the fluoroscope housing in dotted lines;

Figs. 33, 34 and 35 are sectional views of the near side of the fluoroscope housing yoke support as viewed in Fig. 32, illustrating the operation of a latch mechanism for locking the housing in either a vertical or horizontal position;

Fig. 36 is an elevation view from the other end of the X-ray apparatus and illustrating various vertical positions of the fluoroscope housing in dotted lines;

Figs. 37, 38 and 39 are sectional views of the near side of the fluoroscope housing support as viewed in Fig. 36

illustrating the operation of a counterbalance arrangement for the housing;

Fig. 40 is a side view of a portion of the rear wall of the fluoroscope housing to illustrate a Bucky grid reciprocating mechanism;

Fig. 41 is a view taken along the lines 41—41 in Fig. 40;

Fig. 42 is a partial view illustrating the mechanical link coupling between the Bucky grid and its reciprocating mechanism;

Fig. 43 is a partial edge view of an intermediate portion of the link coupling between the Bucky grid and its reciprocating mechanism;

Figs. 44, 45 and 46 are plan views of a modified cassette carrier illustrating additional location stops and their coaction with the film cassette in different positions;

Fig. 47 is a plan view of a modified form of fluoroscope screen housing arranged to assist an operator in aligning the X-ray source; and

Fig. 48 is an enlarged partial sectional view taken along the lines 48—48 in Fig. 47.

Referring now more particularly to the drawings, there is shown an X-ray apparatus having a base 10 which supports a tiltable table, the table being partially illustrated in a horizontal position in Fig. 1 and in a vertical position in Fig. 28 of the drawings. The X-ray tube is operatively supported within the table on a mounting not forming part of this invention and therefore not shown but which is adapted to traverse the length of the table 11 in the usual manner in conjunction with a vertical column 12 as shown, for example, in Letters Patent of the United States No. 2,259,036, granted October 14, 1941, wherein provision is made for traversing movement of the X-ray tube and mounting longitudinally and transversely of the table structure. The vertical column 12 slidably supports a yoke 15 which has parallel spaced hollow arms 16 and 17 for supporting a rectangular housing 20 containing a fluoroscopic screen 22 and having provision for supporting a film cassette carrier 25 therein. The yoke arms 16 and 17 enclose the housing 20 and the vertical column 12 in a manner to be hereinafter more fully described.

In accordance with this invention, the housing 20 also encloses mechanism for moving the carrier 25 from an access storage position adjacent the supporting yoke 15 to multiple selected locations within the exposure area beneath the fluoroscopic screen 22 for single or serial radiographs. The normal position of the housing 20 is shown in Fig. 1 for horizontal fluoroscopy and radiography, but it is to be understood that this housing may be swung away from the supporting surface of the table 11 as shown in dotted lines in Fig. 32 of the drawing so as to clear the table surface to facilitate handling of a patient. The table 11 along with its column 12 and fluoroscopic screen housing 20 may also be tilted on the base 10 to the vertical position shown in Fig. 28 of the drawings, in which case the housing 20 may be positioned vertically along the table surface for vertical fluoroscopic observations or radiographic exposure of selected areas.

The fluoroscopic screen housing 20 embodies a hollow rectangular frame having longitudinally extending side members 30 and 31 which are preferably extruded channel-shaped members with longitudinally extending ribs thereon as indicated at 32 and 33 in Fig. 13 of the drawings. The longitudinal members 30 and 31 are interconnected at their ends to form the hollow frame which is closed by a bottom plate 41. The top is partially closed by the fluoroscopic screen 22, thus leaving an enclosed well which is normally occupied by the film carrier 25 during cassette receiving or radiographic operation.

A film cassette 26 may be positioned within and by the carrier 25 in any of the positions illustrated in Figs. 2 through 12 inclusive. The position of the film cassette 26 within the carrier 25 is determinative of the shape,

size and position of the photographic record to be made. Thus, when the film cassette is positioned at the right of the carrier as viewed in Figs. 2 and 3, quarter size exposures will be made respectively as indicated. The other half of the film cassette may be exposed by moving the cassette to the left side of the carrier as viewed in Figs. 4 and 5, in which case additional quarter size exposures can be made depending upon the position of the carrier in the exposure area. Movement of the carrier from the position shown in Figs. 2 and 4 to that shown in Figs. 3 and 5 is accomplished by means of the automatic positioning mechanism which forms a principal feature of this invention and which will be hereinafter more fully described.

Half size exposures of different sizes of film plates may be made by positioning the film cassette 26 in the carrier 25 in the manner shown in Figs. 6 through 9 inclusive and, similarly, various full size exposures may be made by positioning different size film cassettes in the carrier 25 in the manner illustrated in Figs. 10 through 12 inclusive. Other types of exposures may also be obtained by properly locating the cassette in the carrier. Thus, half-size exposures of the cassette may be obtained in Fig. 10 by locating the cassette to the right and left of the center position in the carrier. It is thus possible, for example, to obtain 4 inch by 10 inch spot-film exposures of an 8 inch by 10 inch cassette. The operating member for conditioning the carrier moving mechanism to automatically position the carrier 25 in the manner aforesaid for the different exposures described is a hand lever 45 which extends through an elongated slot-like opening 44 in the top of the identification plate 19 on the housing 20 around which are marked suitable representations of the different film type exposures obtainable by the corresponding position of the lever.

As hereinbefore noted, the cassette carrier 25 is normally stored at the end of the fluoroscope housing 20 adjacent the supporting yoke 15 where it is readily accessible to an operator for reception of the film cassette 26. The carrier is supported upon grooved rollers 46 like the one shown in the left portion of the broken sectional view of Fig. 13 in engagement with the rib 32; it being understood that the other rollers are similarly guided by the longitudinal extending ribs of the housing side frames 30 and 31 which provide tracks extending substantially the full length of the housing 20 and enable the carrier 25 to be moved into the well beneath the fluoroscopic screen whenever a radiographic record is desired.

The film cassette 26 and carrier 25 are shown in greater detail in Figs. 14 through 16 inclusive where it is seen that the carrier is in the form of a rectangular tray having upturned marginal edges 27 and 28 along the front and rear portions respectively. A U-shaped channel 29 is welded or otherwise mounted along the front upturned edge 27 of the carrier frame to serve as a guide for the carrier motivating mechanism in a manner to be hereinafter more fully described. Each of the side portions of the carrier frame have angled boundary retaining members 47 and 48; the member 48 being Z-shaped to provide a portion adapted to overhang the film cassette 26. These retaining members 47 and 48 when taken in conjunction with the upturned front and rear edges 27 and 28 of the carrier frame comprise a suitable retaining boundary within which the film cassette 26 may be positioned in the manner hereinbefore described in connection with Figs. 2 through 12 of the drawings. The size of the carrier 25 is related dimensionally to the customary or standard sizes of film cassettes so that for example an 8 inch by 10 inch cassette can be accommodated in any one of the positions illustrated in Figs. 2 through 7 and 10 of the drawings, and at the same time the carrier will also accommodate a 10 inch by 12 inch cassette for full exposure as depicted by Figs. 8, 9, and

11 and 12 of the drawings. This arrangement permits great flexibility in the use of different sizes of film cassettes for partial or full exposures when used in conjunction with suitable cassette location stops as hereinafter more fully described. Suitable permanent magnets such as those designated 50 may be mounted in apertures in the rear and front boundary portions of the carrier frame to aid in the fixed retention of the film cassette 26 which generally embodies a metallic frame structure.

In order that the film cassette 26 may be initially positioned within the carrier 25 for the particular type of exposure desired, suitable indexing stops 51 and 52 extend through apertures in the upturned marginal edge 28 of the rear boundary portion of the carrier frame. These stops are capable of being rendered inactive independently of each other by means of a spring bias. This is accomplished by forming the indexing stops as opposed leg extremities of a U-shaped bracket 53 whose base is disposed on the external side of the upturned edge 28, as best shown in the perspective view of Fig. 16 of the drawings. The bracket 53 has a central aperture through which a rivet 54 may be inserted and secured to the upturned rear edge 28 of the carrier frame. A spring leaf 55 having a central aperture is mounted on the rivet 54 in tension so that either leg extremity 51 or 52 of U-shaped member 53 may be pressed outwardly against the corresponding end of the leaf spring to render that particular indexing stop inactive.

In addition to the foregoing, the carrier 25 carries a film cassette ejector in the form of a lever 60 pivoted at one end to the upturned marginal rear edge portion 28 of the carrier frame. This lever 60 carries a transverse rod 61 spaced from the pivot pin 62 and intersecting the cassette supporting area of the carrier through a slot 64 in the upturned rear edge 28. The rod 61 is biased by a spring 65, which coacts between the pivot pins 62 and the lever 60, into a position below the rear cassette supporting boundary of the carrier so that it normally is ineffective. However, by lifting the lever 60 and swinging it through an arc of approximately 150 degrees the rod 61 bears against the bottom of the film cassette 26 and lifts it up at an angle with respect to the carrier 25 so that the weight of the film cassette, acting against the rod 61 after it moves into an over-center position relative to the pivot pin 62, automatically retains the lever 60 in the ejecting position and leaves the operator's hands free to withdraw the film cassette from the carrier. The carrier 25 also supports along a side boundary and adjacent the front edge 27 a U-shaped bracket 59 which in turn carries a rod 58 having a switch engaging projection which coacts in selected positions of the carrier in the housing 20 to automatically condition the X-ray tube energizing circuits for either radiograph or fluoroscopic operation, depending upon whether the film carrier 25 is in the radiographic exposure or storage positions respectively. Operation of this switch engaging member will be hereinafter described in greater detail in connection with the operation of the carrier positioning mechanism.

Referring now more particularly to Fig. 1 in conjunction with Figs. 17 through 27 inclusive, there is shown the control levers and positioning mechanism for selectively moving the carrier 25 to the various desired positions in the X-ray exposure area of the housing 20. The sectional view of Figs. 17 illustrates the condition of this control mechanism when the carrier 25 is partially advanced in the fluoroscopic housing 20. The positioning mechanism includes a linkage system which maintains a positive connection between the housing frame and the carrier at all times and which is adapted to extend or retract as the carrier is positioned forwardly into the exposure area or rearwardly into the storage position of the housing 20.

Longitudinal positioning of the carrier 25 is accomplished by rotating an externally accessible knob 80 which operates to rotate a gear segment 82 that is rotatably

supported on a shaft 81 on the housing side frame 30 above the path of the carrier movement. The knob 80 rotates a drive-link assembly 34 which has a link connection 35 to the gear segment 82. The drive link assembly 34 carries a spacer member 36 that is normally engaged by an eccentric portion 39 on a pivoted lock-plate 49 which is spring-biased into engaging position. The drive-link assembly 34 is released by depressing the lock-shaft 63 which extends through the knob 80 for engagement against the eccentric portion 39. With this arrangement, the knob 80 can only be rotated to position the cassette carrier when the lock-shaft 63 is depressed. As the gear segment 82 rotates, it engages a movable rack 83 disposed in the U-shaped channel 84 along interior of the housing side frame 30 as best shown in the left hand portion of Fig. 13. The rack 83 in turn engages and rotates another gear segment 85 which is similarly mounted on a second shaft 78 on the housing side frame 30 rearwardly from the handle operated gear segment 82. The gear segment 85 is carried at one extremity of a primary lever 86 which in turn is pivotally connected at 87 to one end of a secondary lever 88. The secondary lever 88 carries a roller 89 on a vertical axis which is disposed for guidance in the U-shaped guide channel 29 mounted on the forward edge 27 of the carrier frame. Thus, as the knob 80 is rotated it transmits the rotation through the rack 83 to the primary and secondary levers 86 and 88 which operate through their pivotal connection to move the carrier 25 longitudinally into or out of the exposure area of the housing 20.

This carrier movement is controlled by pivotally connecting an anvil-like portion of the secondary lever 88 to one end of an intermediate link 90 of a compound linkage including a striker plate 91. The striker plate 91 is rotatably mounted on the same axis 78 as the gear segment 85 and has an extended link portion pivotally coupled at 92 to the other end of the intermediate link 90 for coaction with the secondary and primary levers 88 and 86 during rotation of the gear segments 82 and 85 to selectively limit the extent of longitudinal movement of the film carrier 25 within the housing 20 in a manner determined by the position of the selector handle 45 as sequentially shown in Figs. 19 through 24 inclusive. This is accomplished by moving the selector handle 45 to selectively position a stop member 96 into the path of the striker plate 91. Figs. 19 through 24 of the drawings illustrate respectively the selection (Fig. 19) and attainment (Fig. 20) of the carrier position corresponding to Fig. 25; the selection (Fig. 21) and attainment (Fig. 22) of the carrier position corresponding to Fig. 26; and the selection (Fig. 23) and attainment (Fig. 24) of the position corresponding to Fig. 27.

Thus, when the selector handle 45 is positioned forwardly as shown in Fig. 19 it operates through a lost motion connection to move the stop member 96 into a predetermined position relative to the striker plate 91. The lost motion connection includes a pin 97 carried by a depending portion of the selector handle 45 and a slotted groove 99 in the adjacent end of a connecting link 100 which, in turn, is pivotally connected at its other end to the stop member 96. Under the condition illustrated in Fig. 19 the forward anvil portion 101 of the stop member 96 will engage the innermost notch of the striker plate 91 and will stop its pivotal movement, thereby transferring the pivotal axis of the primary and secondary levers 86 and 88 from the gear segment 85 and striker plate 91 to the pivotal connection 92 between the striker plate 91 and the intermediate link 90. Further movement of the rack 83 will rotate the pivotal connection between the secondary lever 88 and the link 90 about this transferred axis and at the same time rotates the secondary lever 88 until it reaches a null or zero velocity position at the dead center of its arc of movement designated by the dash-dot line. It will be readily apparent that the extremity of the secondary lever 88 follows a

simple harmonic motion and decelerates to zero velocity at the null point so that the film carrier 25 is positively moved into and aligned with a pre-selected position within the housing 20 without being subject to the danger of misalignment that might otherwise occur due to rebound from stop or check members interposed in its path of travel. Thus, the operator is assured of accurate carrier movement into a selected position in the exposure area corresponding to a desired exposure sequence without fear of overrunning or otherwise misaligning the carrier and film cassette.

A retaining device is provided along one edge of the secondary lever 88 by forming an inwardly turned portion 105 which engages the adjacent end of the intermediate link 90 when the moving extremity of the secondary lever 88 reaches the null point in its arc of movement. This, however, is intended merely to assist the lever and linkage systems to maintain the attained position of the carrier 25 fixed. A take-up spring 94 coacts between the primary lever 86 and the striker plate 91 to insure proper return of the combined lever-linkage system and also to restrict free movement of the carrier.

It will be seen by reference to Figs. 19 through 24 that the side frame 30 of the fluoroscopic housing 20 in which the selector handle operating mechanism is mounted is also provided with a slot 106 adjacent the selector handle 45 and above its pivotal connection thereto. A projection 107 carried by the rack 83 extends through this slot and will intersect the arcuate path of the rear anvil portion 103 of the selector handle 45. Thus, when the selector handle 45 is moved forwardly, as shown in Fig. 19, its rear anvil portion 103 will be positioned for engagement by the rack projection 107 upon rotation of the knob 80 to return the selector handle 45 to its neutral position while the film carrier 25 is positioned forwardly into the position shown in Fig. 25. The return of the selector handle 45 to its neutral position places the spring 109 under tension and biases the connecting link 100 in a direction to return the stop member 96 to a non-engaging or neutral position as the cassette is returned to inactive position. When the selector handle 45 and stop member 96 are in this neutral position, which condition is illustrated in Figs. 21 and 22, the carrier positioning mechanism is automatically conditioned to move the film carrier 25 from the positions shown in Figs. 2, 4, 6 or 8 to those shown in Figs. 3, 5, 7 or 9 respectively for sequential exposure of quarter or half sections of the radiographic film plate. Thus, once the film cassette has been properly located in the carrier as in Figs. 2, 4, 6 or 8 it is unnecessary to again adjust the selector handle 45 in order that the second sequence, that is, the second quarter or the second half of the film respectively can be exposed. It is only necessary that the knob 80 be rotated each time to position the rack 83 to move the film carrier 25 first into the position of Fig. 25 and then into the position of Fig. 26.

Figs. 23 and 24 of the drawings, correspond respectively to the selection and attainment of the centered carrier position shown in Fig. 27 to permit the exposures shown in Figs. 10 and 11 of the drawings. The carrier positioning mechanism is conditioned for this carrier position by moving the selector handle 45 rearwardly, or to the left as viewed in these figures, to rotate the stop member 96 so that its rear anvil portion 102 is positioned into the path of the striker plate 91. The distance between the forward anvil portion 101 and rear anvil portion 102 is such that the rear portion will only engage the outermost notch in the striker plate 91, thereby permitting the striker plate to rotate further than was permitted by the forward anvil portion 101. Similarly to the operation in Figs. 19 and 20 of the drawings, once the latch notch of the striker plate 91 is engaged by the rear anvil portion 102 of the stop member 96, the pivot point is transferred from the shaft 78, which is common to the striker plate 91 and gear segment 85, to the pivotal connection be-

tween the striker plate 91 and the intermediate link 90; thus permitting the primary and secondary levers 86 and 88 to move through their respective arcs of movement until the axis of the roller 89 on the secondary lever 88 arrives at a null or zero velocity position in the forward direction. As shown in Fig. 27, this corresponds to a center-line carrier position intermediate the extreme carrier positions shown in Figs. 25 and 26 of the drawings. Since this is a single full exposure position, no automatic return of the selector handle 45 is necessary and hence the rack projection 107 does not engage the rear anvil portion 103 of the selector handle in its path of movement.

In summation, it may be stated that the carrier positioning mechanism may be selectively conditioned to move the film carrier 25 into the first position shown in Fig. 25 by moving the selector handle 45 forwardly or to the right as viewed in Fig. 19. Since the sequence of exposures usually desired in either in quarter or half sections of a film packet carried in the cassette 26, it is desirable that the further movement of the film carrier 25 into the position of Fig. 26 be automatically conditioned so that after the first exposure in a sequence it is only necessary for the operator to rotate the knob 80 to accomplish the further movement of the film carrier. This is accomplished by providing a projection 107 on the rack 83 to return the selector handle 45 to its neutral position which in turn conditions the stop member 96 for retraction into the neutral or inactive position of Figs. 21 and 22 of the drawings upon return of the cassette carrier to the inactive position. In this inactive position of the stop member 96 it will not engage the striker plate 91 and permits the combined lever-linkage system to move the film carrier 25 to its furthest extent (Fig. 26) within the fluoroscopic housing 20. Each carrier movement terminates at a null point in the forward component of its arc of movement, thereby providing for positive positioning and accurate alignment of the film carrier and film packet with the source of X-rays for each condition of exposure. The center line or intermediate position for the film carrier 25 shown in Fig. 27 accommodates the film cassette in the manner illustrated in Figs. 10 and 11. This condition is illustrated in Figs. 23 through 24 where the selector handle 45 is positioned rearwardly or to left as viewed in the drawings to move the stop member 96 to a position where its rear anvil portion 102 will engage the last notch on the striker plate 91 to restrict the travel of the combined lever-linkage system to the position shown in Figs. 27. In each case, there is no danger of misalignment or erroneous positioning of the carrier and film cassette. All the operator need do is properly position the selector handle 45 to condition the carrier positioning mechanism for a different amplitude of movement corresponding to a selected exposure sequence and then activate the mechanism by operating the knob 80 in the manner hereinbefore described.

As is well understood in the art, the operating level of the X-ray tube energizing circuit is usually different when the apparatus is intended for radiography than when used for fluoroscopy. An arrangement for automatically conditioning the energizing circuit for the correct level of operation corresponding to its application for radiography or fluoroscopy is illustrated in the schematic circuit diagram in Fig. 30 in conjunction with the switch control mechanism on the carrier 25 best shown in Fig. 15 of the drawings. The manner in which the X-ray tube energizing circuit may be conditioned to operate at different levels is well understood in the art and Fig. 30 merely illustrates how a control branch of the main energizing circuit may be activated by means of a normally closed switch 56 which is supported in a casing 57 on the fluoroscopic housing 20 and adapted for operable engagement by the rod 58 which forms part of the switch control mechanism. The rod 58 is supported by the U-

shaped bracket 59 mounted on the right forward corner of the carrier 25 when viewed in Fig. 15 and operates in conjunction with the switch arm 70 so that when the carrier 25 is located in the storage position the switch arm 70 is engaged by the rod 58 to open the control branch of the energizing circuit and thereby to condition that circuit for fluoroscopic operation. In the alternative, when the carrier 25 is moved forward into exposure position in the fluoroscopic housing 20 for radiograph operation, the switch arm 70 is disengaged from the operating rod 58 and the control branch of the energizing circuit is closed and conditioned for radiographic operation of the X-ray tube. Each operation is diagrammatically shown in Figs. 30 and 31 respectively. Reference to Fig. 30 indicates the inclusion of additional branch circuits which will be hereinafter more fully described.

X-ray apparatus which is intended for radiographic operation usually includes a Bucky grid 23 which is vibrated in a conventional manner during the radiographic exposure to assure a clear photographic print. The vibration may be accomplished by engaging spaced rollers 66 and 67 on a grid connecting link 68 with a reciprocating cam 71 as shown in Figs. 40 through 42. The cam 71 is preferably rotated through a gear train 72 by a suitable motor 73. It will be seen that Fig. 30 includes a branch circuit for energizing the motor 73. This branch circuit includes a safety switch 74 which is intended to be closed by the extension of the grid connecting links 68 and 69 as shown in Figs. 17 and 42 or the drawings when the grid 23 and carrier 25 are positioned in the radiographic exposure area of the housing 20. The link 69 is pivotally connected to a bracket 37 on the rear edge of the grid and a handle 38 is hinged to this bracket to permit manual positioning of the grid as best shown in Figs. 17 and 43 of the drawings.

Energization of the grid reciprocating motor 73 should preferably occur at the same time as the main X-ray tube energizing circuit is conditioned for radiographic operation and this is accomplished in the circuit of Fig. 30 by connecting the reciprocating motor branch energizing circuit in parallel with another branch circuit for energizing an X-ray tube anode rotor mechanism 75 through a normally open switch 76 which is adapted to be closed in energization position by means of a relay coil 77 connected in series in the control circuit that is energized by the switch 56. With this arrangement, when the carrier 25 is positioned in the radiographic exposure position the switch arm 70 is positioned to automatically condition the X-ray energizing circuit for the corresponding level of operation. At the same time, the branch circuits for activating the X-ray tube anode rotor mechanism 75 and the grid reciprocating motor 73 are similarly energized; the latter including the safety switch 74 which prevents jamming of the grid reciprocating mechanism when the grid 23 is retracted and the carrier 25 is returned to its storage or fluoroscopic operating position.

In this connection, reference is also made to the diagrammatic illustrations of Fig. 12 which illustrates the disposition of a large film cassette 26A within the fluoroscopic housing 20 without the aid of the carrier 25 as a support. The large film cassette 26A is simply inserted through the end access opening 21 in the housing 20 so that it rests on top of the grid guides 24 as shown in the right hand portion of Fig. 13. This large film cassette 26A may then be pushed against the channel guide 29 which locates the cassette at approximately the center of the fluoroscopic area where it can be exposed for a complete picture. Since the carrier 25 is still in the storage of fluoroscopic position within the housing 20 when the large film cassette 26A is being exposed, the switch arm 70 is not positioned by the carrier to condition the X-ray tube energizing circuit for radiographic operation. This may be readily accomplished, however, by providing an extension in the opposite direction for

the switch operating rod 58, best shown in Fig. 15, and mounting a bracket 93 thereon with a depending portion which is adapted to engage the adjacent end of the large film cassette 26A when the cassette is fully inserted into the housing 20. This then positions the rod 58 axially until it disengages the switch arm 70 and opens the control circuit to condition the X-ray tube energizing circuit for radiographic operation.

A still further control feature shown in Fig. 30 is the inclusion of another branch circuit which will energize a relay 95 to close the normally open switch 79 whenever the safety switch 74 is closed. The switch 79 completes a photo-timing compensating circuit 42 which is designed to introduce a compensating voltage into the main X-ray tube energizing circuit to offset absorption of X-rays by the grid 23. The details of the compensating circuit do not form part of this invention and therefore are not shown.

Another feature of this invention relates to a releasable latch shown in Figs. 32 through 35 for locking the fluoroscopic housing 20 in the vertical position shown by dotted lines in Fig. 32. This latch mechanism is disposed within one hollow side arm 17 of the supporting yoke 15 as shown in Figs. 33, 34 and 35. The fluoroscopic housing 20 is shown pivoted at 110 on the forward extremity of the yoke side arms 16 and 17 and includes a sliding link connection 111 with the side arm 17. The link 111 is pivotally connected at one end to the fluoroscopic housing 20 and at the other end carries a pin 112 which engages a slot 113 in the adjacent face of the side arm 17 so that as the housing 20 is tilted to a vertical plane the extremity of the link 111 engaging the slot 113 moves forwardly along the slot until it engages a notch 114 in a pivotally supported latch member 115. The forward extremity of the latch member 115 is spring biased to a fixed plate 116 on the side arm 17 and has a link connection 117 on a pivoted pawl 118 which engages a pin 119 on the housing 20 to hold the housing 20 in horizontal position until the latch member 115 is depressed by applying manual pressure on the externally accessible control pin 120. Depression of the control pin 120 also releases the latch assembly to permit retraction of the fluoroscopic housing 20 from the vertical to the horizontal position.

As best shown in Figs. 36 through 39, the fluoroscopic housing 20 is counter-balanced in its vertical position as viewed in Figs. 32 and 36 by means of a coiled spring 123 which is secured at one end to the yoke side arm 16 and at the other end to a sprocket chain 124 which extends about a sprocket wheel 125 fixed on the housing pivot shaft 110. Since the spring is designed to offset the weight of the housing 20 when the table 11 is disposed horizontally, it will be apparent that unless this counterbalancing force is released or rendered inactive when the table 11 is positioned vertically, the force of the spring 123 will tend to swing the fluoroscopic housing 20 outwardly from the table surface. In order to offset this counterbalance force when the table 11 is positioned vertically, there is provided within the side arm 16 a pivoted pawl 126 which is biased for engagement with the sprocket chain links by a spring 127, thus preventing contraction of the counterbalancing spring 123 and inadvertent outward swinging movement of the fluoroscopic housing 20 when the table is vertically disposed as in Fig. 28. This device is rendered inactive when the table 11 is disposed horizontally by counterbalancing the pawl 126 with a weight 128 on its opposite extremity, the weight 128 being designed to maintain the pawl 126 out of engagement with the sprocket chain links when the table 11 is disposed in horizontal position. The entire counterbalancing assembly is suitably enclosed within the yoke side arm 16.

Referring now to Figs. 44 through 46 inclusive, there is shown a modified construction for the film cassette carrier 25 utilizing a combination of multiple film cassette

location stops for holding a standard 8 inch by 10 inch film cassette in each of the three stations shown respectively in Fig. 44 for exposure of the lower half of the film, in Fig. 45 for exposure of the entire film, and in Fig. 46 for exposure of the upper half of the film. The location stops are in the form of bullet-shaped pins 130 having blunt noses and secured in predetermined spaced relation at the extremities of leaf springs like 131 and 132. These leaf springs are secured by rivets or the like intermediate their ends to the front and rear marginal frame boundaries of the carrier 25 respectively, and these frame boundaries are also provided with suitable apertures aligned with the corresponding location stop pins and designed to permit free movement of the stop pin therethrough in the manner hereinbefore described in connection with the cassette carrier shown in Fig. 15 of the drawings. This arrangement will effectively hold the film cassette in the desired location in the fluoroscopic housing regardless of the position of the table 11 relative to the floor.

Figs. 47 and 48 illustrate a simple and economical arrangement for assuring an operator that the beam of X-radiation is not exceeding the area limits of the fluoroscopic screen 22 in the apparatus shown and described in Fig. 1 of the drawings. The arrangement contemplates modifying the fluoroscope housing 20 by providing an overhanging marginal frame boundary 135 around the screen opening. This boundary frame 135 is provided with slit-like apertures 136 in the frame portion which overhangs the screen 22. An X-ray beam having a width equal to or greater than the width of the screen 22 will thus be visible as fluorescent light through the apertures 136, and the operator will thus be warned to adjust the control diaphragms to narrow the X-ray beam angle until the light pattern is no longer visible through the apertures 136.

Thus, there has been provided an X-ray apparatus which may be automatically conditioned for fluoroscopic or radiographic operation in response to positioning of a film cassette carrier in either a storage or active exposure location within a housing carrying a fluoroscopic screen. The automatic conditioning of the X-ray energizing circuit controls a mechanism for reciprocating the Bucky grid and also activates a photo-tube compensating circuit and an anode rotating mechanism for radiographic operation. Movement of the cassette carrier to either of three exposure locations within the fluoroscope housing is accomplished by simply positioning a selector handle on the housing and thereafter manually rotating a knob which moves the carrier to the desired location. The moving mechanism operates to positively locate the carrier in the selected position by converting manipulation of the knob into a simple harmonic mechanical movement that decelerates to a null point of zero velocity in the path of movement at the selected carrier position. The amplitude of the harmonic motion determines the extent of carrier movement and is controlled by the selector handle. This eliminates the need for external stop or check members and assures positive alignment of the carrier with the X-ray beam in the selected location without undue vibration or mechanical strain.

Additional features include a releasable latch mechanism which automatically secures the fluoroscopic screen housing in vertical or horizontal position and a counterbalance arrangement to assist in elevating the housing from a horizontal to a parked position. The counterbalance arrangement includes a latch that is automatically activated to release the counterbalancing force when the table is disposed in a vertical position, thereby preventing inadvertent outward swinging movement of the fluoroscopic housing.

There are also provided improved arrangements for locating a film cassette in different positions within the carrier to accommodate different exposure sequences and different film sizes. The apparatus also embodies a modi-

fied arrangement for supporting the fluoroscopic screen which coacts with the X-ray beam to warn an operator when the beam width exceeds the screen area, thereby permitting the operator to adjust the diaphragms and reduce excessive radiation. These and other structural features of this invention have been so assembled and designed as to form an improved X-ray apparatus which permits easier and more accurate operation resulting in improved X-ray technique.

We have shown and described what we consider the preferred embodiment of our invention along with suggested and modified forms, and it will be obvious to those skilled in the art that other changes and modifications, particularly with respect to the adoption of the carrier motivating mechanism to different types of picture sequences than those exemplarily illustrated herein, may be made without departing from the scope of our invention as defined by the appended claims.

We claim:

1. In an X-ray apparatus, a hollow fluoroscope housing having a fluorescent screen forming a portion of one wall and defining an X-ray exposure area, the remaining portion of said one housing wall being open to provide access to a film cassette in the housing, a cassette carrier disposed in the housing and adapted for selective reciprocable movement between the film access and multiple exposure areas in the housing where each exposure area corresponds to a different predetermined exposure location for the film, and adjustable means for selectively reciprocating the carrier into and out of each exposure area in a simple harmonic motion the maximum amplitude of which can be adjusted to coincide with the selected exposure area.

2. The apparatus of claim 1 wherein said last-mentioned means includes a primary lever having one end pivoted on the housing and the other end extending into the path of carrier movement but displaced from the plane of the carrier, a secondary lever having one end pivotally coupled to said other end of the primary lever and having its free end movably coupled to the carrier, said movable coupling including means on the carrier for guiding said free end of the secondary lever in a fixed path transverse to the direction of carrier movement; a link member having one end pivotally connected intermediate the ends of the secondary lever and having its other end pivotally coupled to the housing, means for rotating said primary lever a predetermined distance about its pivotal connection to the housing, said link member coacting between the primary and secondary levers and the housing to limit the maximum radius of the arc of travel of the free end of the secondary lever into the exposure area of the housing, and means for selectively changing the coaction between the link and the levers to vary the maximum travel distance of the free end of the secondary lever.

3. In an X-ray apparatus, a hollow fluoroscope housing having a fluorescent screen forming a portion of one wall and defining an X-ray exposure area, the remaining portion of said one housing wall being open to provide access to a film cassette in the housing, a cassette carrier disposed in the housing and adapted for reciprocable movement between the film access and exposure areas of the housing, means for selectively reciprocating the carrier into and out of the exposure area in a simple harmonic movement the maximum amplitude of which coincides with a predetermined film exposure location, and means for selectively changing the maximum amplitude of carrier movement into the exposure area to vary the film exposure location.

4. The apparatus of claim 3 wherein said reciprocating means includes a primary lever pivoted on the housing and having its other end extending into the path of carrier movement but displaced from the plane of the carrier, a secondary lever having one end pivotally coupled to the other end of the primary lever and having its free end movably coupled to the carrier for movement in a fixed

path transverse to the direction of carrier movement, a link having one end pivotally connected intermediate the ends of the secondary lever and having its other end pivotally coupled to the housing, means for rotating the primary lever a predetermined distance about its pivotal connection to the housing, said link coacting between the levers and its coupling to the housing to limit the maximum distance of travel of the free end of the secondary lever into the exposure area, and settable means on the housing for selectively shifting the pivotal coupling between the link and the housing to change the maximum travel of the free end of the secondary lever into the exposure area.

5. The apparatus of claim 4 wherein said pivotal coupling between the link and the housing includes a striker member pivoted on the housing and having an extended arm portion pivotally connected to said other end of the link and wherein said settable means includes a stop member adjustably supported on the housing adjacent the striker member and having multiple spaced anvil portions adapted to be selectively interposed into the path of movement of said striker member for stopping engagement with different portions of the striker member respectively, whereby the pivotal connection between the extended striker arm portion and the link is selectively fixed in different positions relative to the housing corresponding to the desired maximum travel distance of the free end of the secondary lever into the exposure area, and means on the housing for selectively setting the adjustment of the stop member for the desired exposure condition.

6. In an X-ray apparatus, a hollow fluoroscope housing having a fluorescent screen forming a portion of one wall and defining an X-ray exposure area, the remaining portion of said one housing wall being open to provide access to a film cassette in the housing, a cassette carrier disposed in the housing and adapted for reciprocable movement between the film access and exposure areas of the housing, means for selectively reciprocating the carrier into and out of the exposure area in a simple harmonic movement the maximum amplitude of which coincides with a predetermined film exposure location, means for changing the maximum amplitude of carrier movement into the exposure area to vary the location of the film in the exposure area, and means operative in response to carrier movement into the exposure area to automatically condition said amplitude changing means to change the amplitude for the next succeeding carrier movement in accordance with a predetermined sequential film exposure pattern.

7. The apparatus of claim 3 wherein the cassette carrier includes multiple releasable film cassette stops adapted to engage and hold the film cassette in different predetermined positions within the carrier corresponding to different film exposure patterns.

8. The apparatus of claim 7 wherein the amplitude changing means includes settable control means having a predetermined relation to the size of the film cassette and the location of the cassette stops to permit multiple exposure of the film in a selected pattern.

9. In an X-ray apparatus having a source of X-rays conditioned for fluoroscopic operation, a hollow fluoroscope housing having an X-ray exposure area adapted to receive a film cassette, means in the housing providing multiple cassette delivery access to the exposure area from different directions, a cassette carrier stored in the housing in spaced relation from the exposure area and adapted for delivery to the exposure area from one direction, a normally inactive circuit including a switch for conditioning the source of X-rays for radiographic operation, a switch control member mounted on the carrier and adapted to operate the switch to activate the circuit when the carrier is delivered into the exposure area, and means on the switch control member adapted for activating switch by coaction with a cassette delivered to the

exposure area from another direction when the carrier is stored within the housing.

10. The apparatus of claim 9 wherein said switch includes a switch arm biased and extending into the path of carrier movement and surmounting the plane of the carrier, and wherein said switch control member is mounted on the carrier for inactivating engagement with the biased switch arm when the carrier is in the stored or fluoroscopic position within the housing, whereby the switch arm is released to activate the radiographic conditioning circuit when the carrier is moved toward exposure position.

11. The apparatus of claim 10 wherein said switch arm carries an elongated head extending in the direction of carrier movement and wherein said switch control member is in the form of a rod having one end turned inwardly for engagement with said head and carrying a depending abutment at its other end, and a bracket slidably supporting said switch engaging rod on the carrier with its axis parallel to the direction of carrier movement and with the end having the abutment extending beyond the carrier towards the exposure area of the housing, whereby said switch engaging rod may be positioned together with the carrier by carrier movement towards the exposure area to disengage the switch arm head or whereby said rod may be slidably positioned in the opposite direction by a film cassette located in the exposure area when the carrier is retracted into storage position.

12. An X-ray film cassette carrier comprising, a rectangular frame boundary forming a marginal cassette supporting surface having a dimensional relationship to the size of the cassette adapted to support the cassette in more than one position therein, a raised cassette retaining wall disposed along at least one of the marginal boundaries, and a plurality of independently retractable stop means carried by the retaining wall and adapted to selectively intersect the plane of the cassette for interlocking coaction therewith in corresponding selected positions of the cassette on the carrier.

13. The cassette of claim 12 wherein said cassette retaining wall carrying the stop means has an aperture therethrough and wherein said stop means includes a plunger adapted to extend through the aperture and a spring bias coacting between the plunger and the retaining wall to normally urge the plunger through the aperture into the plane of the film cassette.

14. The cassette of claim 12 wherein the cassette retaining wall carrying the stop means has a pair of apertures spaced along the plane of the cassette and wherein said stop means includes a pair of similarly spaced plungers adapted to extend through the corresponding apertures, and resilient means coacting between the retaining wall and each plunger to independently bias each plunger through the aperture and into the plane of the film cassette, whereby said cassette may be held fixed in either location corresponding to the location of each plunger.

15. An X-ray film cassette carrier comprising, a rectangular frame boundary forming a marginal cassette supporting surface having one rectangular dimension greater than any dimension of the cassette and having marginal up-turned edges at opposite sides forming front and rear cassette retaining walls, each of the other side walls having a vertically disposed member forming a side cassette retaining wall, and retractable stop means carried by a cassette retaining wall corresponding to the greater frame dimension and adapted to intersect the plane of the cassette to limit cassette movement in the direction of said greater dimension.

16. An X-ray film cassette carrier comprising a rectangular frame boundary forming a marginal cassette supporting surface a raised cassette retaining wall disposed along at least one of the marginal frame boundaries, and normally inactive cassette ejector means carried

by said retaining wall and adapted to engage and lift the cassette away from the supporting surface of the carrier.

17. The cassette carrier of claim 16 wherein said retaining wall includes a notch and wherein said ejector means includes a lever pivotally mounted on the retaining wall adjacent the notch for rotation in a plane transverse to the plane of the cassette supporting surface and having a pin extending through the notch towards and parallel to the plane of the cassette supporting surface, whereby rotation of the lever raises the pin to lift the cassette away from the supporting surface.

18. In an X-ray apparatus, the combination of a supporting yoke having parallel spaced side arms, a rectangular frame fluoroscope housing pivotally supported intermediate its ends on an axis extending through the extremities of the yoke side arms, one of said side arms being hollow, a latch mechanism operatively disposed within said hollow side arm and adapted for releasable locking coaction with the housing in at least two predetermined pivotal positions of the housing, said latch mechanism including a link having one end pivoted on the side of the housing adjacent said hollow side arm, the free end of said link having a transverse pin, the adjacent side arm wall having a slot for receiving and guiding said pin as the free end of the link follows movement of the housing, a plate having one end pivoted on the interior of said side arm wall and having a pin-receiving notch adjacent its free end, means resiliently biasing said plate to normally position the notch adjacent one end of the pin guide slot, said pin and plate notch adapted to coact in engagement to hold the housing in one of the predetermined pivotal positions, other latch means coacting between the plate and housing in the other pivotal position, and means for selectively releasing said latch mechanism, said latch-releasing means including an externally accessible plunger extending into the hollow side arm for engagement with the free end of said plate in a direction opposed to the plate bias.

19. The apparatus of claim 18, wherein said other latch means includes a pawl having one end pivotally connected to said side wall of the hollow side arm and including a link coupling to said pivoted latch plate, the adjacent end of said fluoroscope housing having a transverse pin adapted to be engaged by the pawl when said housing is positioned in the other predetermined pivotal position, said link coupling adapted for coaction between the latch plate and the pawl to disengage the pawl from said housing pin when said latch releasing plunger is depressed.

20. In an X-ray apparatus having a tiltable table the combination of, a supporting yoke carried by the table and having parallel spaced side arms, a fluoroscope housing pivotally supported on a rotatable shaft extending between the side arms on an axis parallel to the plane of the table for movement towards and away from table, one of said side arms being hollow, means operably disposed within the hollow side arm to counterbalance the weight of said housing when the table is disposed in a horizontal plane, and other means for automatically rendering said counterbalance means inactive when the table is tilted into a vertical plane.

21. The apparatus of claim 20 wherein said counterbalance means includes a coiled spring having one end anchored to the side arm and having a flexible connection between its other end and the rotatable shaft.

22. The apparatus of claim 21 wherein said last-mentioned means includes a pawl pivotally connected intermediate its ends to the side arm on an axis parallel to said rotatable shaft and having one end surmounting the flexible connection, means biasing said pawl into engagement with said flexible connection to isolate the counterbalancing force of the coiled spring from the shaft, the other end of said pawl having a counterweight adapted

to offset said bias when the table is horizontally disposed.

23. In an X-ray apparatus having a tiltable table the combination of, a supporting yoke carried by the table and having parallel spaced hollow side arms, a rectangular frame fluoroscope housing pivotally supported on a rotatable shaft extending between the side arms on an axis parallel to the table for movement towards and away from the table, a latch mechanism operably disposed within one of said hollow side arms and adapted for releasable locking coaction with the housing in at least two predetermined pivotal positions, an externally accessible device for selectively releasing said latch mechanism, means operably disposed within the other hollow side arm to counterbalance the weight of the housing when the table is horizontal, and other means for automatically rendering said counterbalancing means inactive when the table is tilted into a vertical position.

24. A fluoroscope housing having a fluorescent screen surmounting an X-ray exposure area adapted to intersect a beam of X-rays, and means on the housing coacting with the screen to indicate when the beam angle exceeds the area limits of the screen.

25. The fluoroscope housing of claim 24 wherein said indicating means includes a marginal frame surrounding the screen on the housing and having a portion overhanging the edges of the screen, said overhanging portion having a through aperture on each side of the screen to expose visible light from the screen whenever the beam-angle is sufficiently great to equal or exceed the area limits of the screen.

26. In an X-ray apparatus having a film cassette carrier adapted to be reciprocated into and out of a selected exposure location within a fluoroscope housing, means for selectively reciprocating the carrier in accordance with a simple harmonic motion the maximum amplitude of which coincides with the selected exposure location, said means including a primary lever having one end pivoted on the housing and the other end extending into the housing, a secondary lever pivotally connected at one end to the other end of the primary lever and having its free end movably coupled to the carrier, means on the carrier for guiding the free end of the secondary lever in a fixed path transverse to the direction of carrier movement, a link pivotally coupling said secondary lever to a relatively fixed position on the housing and adapted for coaction therewith to limit the maximum radius of the arc of travel of the free end of said secondary lever into the exposure location, and means for rotating said primary lever a predetermined distance about its pivotal connection to the housing.

27. In an X-ray apparatus having a hollow fluoroscope housing adapted to receive a film cassette carrier for reciprocation between a storage and a radiographic exposure position therein, a movable linkage system adapted for coaction within the housing to reciprocate the cassette carrier, an externally accessible handle rotably carried by the housing and having a drive-link connection with said movable linkage system whereby rotation of the handle reciprocates the cassette, and manually releasable latch means coacting between the handle and the housing to lock the handle against rotation, said latch means including a lock-plate pivotally mounted on the housing and biased into locking engagement with said drive-link connection and a depressible lock-shaft extending through the handle into engagement with said lock-plate, whereby depression of the lock-shaft disengages the lock-plate from the drive-link connection to permit free rotation of the handle and carrier reciprocating movement of the linkage system.

28. An X-ray film cassette carrier comprising, a rectangular frame boundary forming a marginal cassette supporting surface having a dimensional configuration related to each of a series of progressively increasing cassette sizes in a predetermined manner whereby the largest size cassette can be supported in one exposure position and

the smaller size cassettes of the series can be selectively supported in more than one exposure position on the carrier, and retractable stop means carried by the marginal boundary and adapted for automatic interposition into the plane of the smaller cassettes to interlock and hold them in a selected exposure position on the carrier.

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References Cited in the file of this patent

UNITED STATES PATENTS

2,534,623	Pitts et al.	Dec. 19, 1950
2,552,858	Mueller et al.	May 15, 1951
2,679,599	Stuhlman	May 25, 1954
2,668,913	Goldfield et al.	Feb. 9, 1954
2,709,221	Haupt et al.	May 24, 1955