

[54] X-RAY CASSETTE HOLDER

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[58] Field of Search 74/422; 83/206, 458; 250/66, 105; 254/97; 269/106, 107, 201, 202, 204, 218, 227, 228, 61, 275

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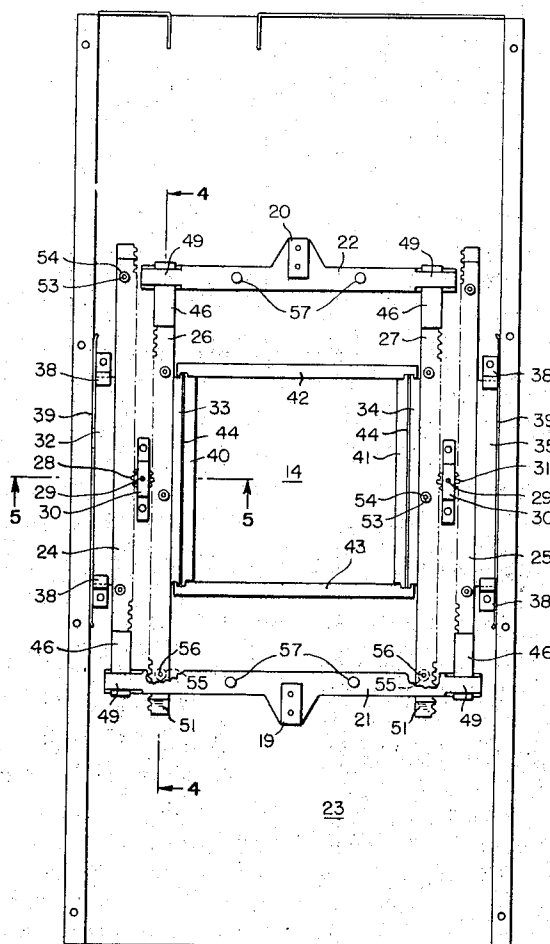
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[57]

ABSTRACT

The centering jaws of an x-ray cassette holder are connected to each other by two pairs of racks. The racks in each pair face each other and engage pinion gears rotatably mounted on the holder between the racks. The racks are connected by dovetail joints to crossbars attached to the centering jaws. The dovetail joints permit the ends of the racks to move laterally along the crossbars to compensate for misalignment of the racks. The jaws may be locked in place by a locking assembly attached to one of the jaws. The locking assembly is adapted to grip the top plate of the holder and then press the centering jaws together to grip the film cassette more securely. Means are also provided for adjusting the gripping force exerted on the top plate.

11 Claims, 8 Drawing Figures



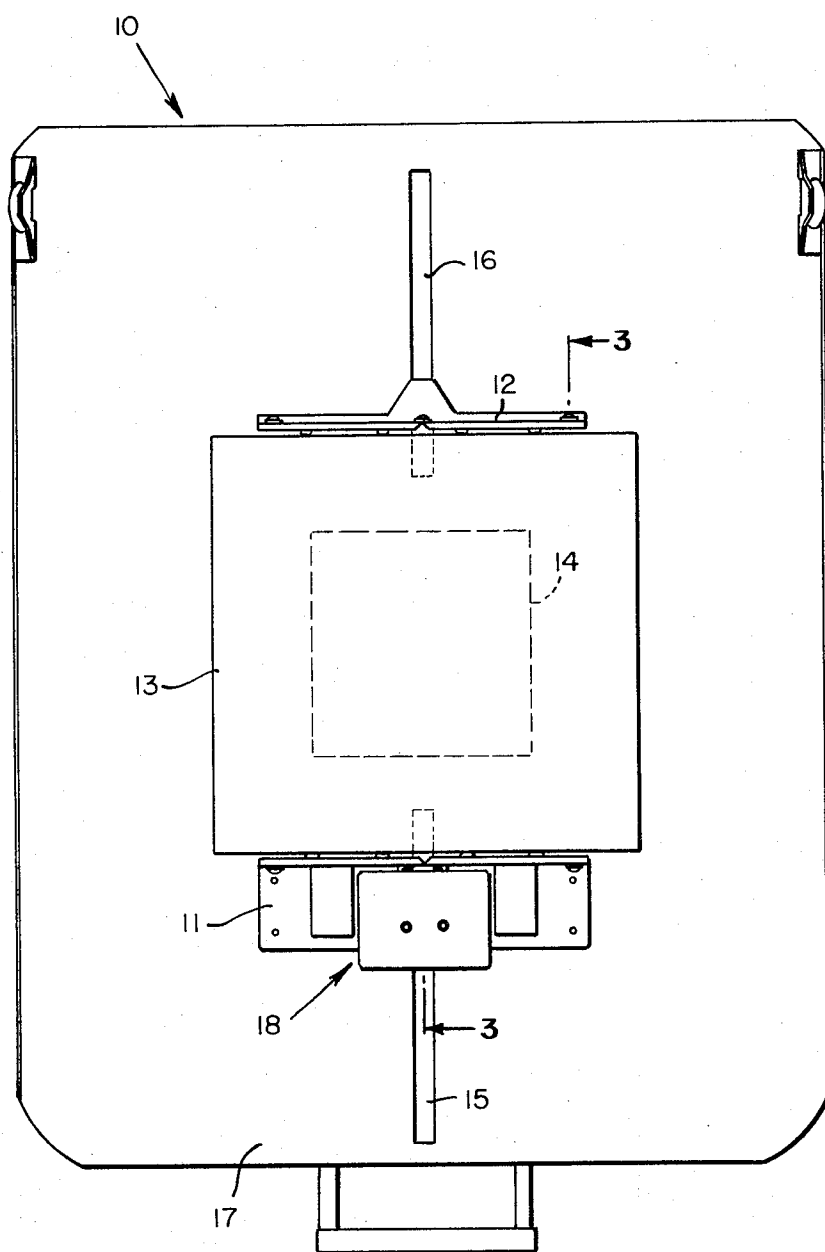


FIG. 1

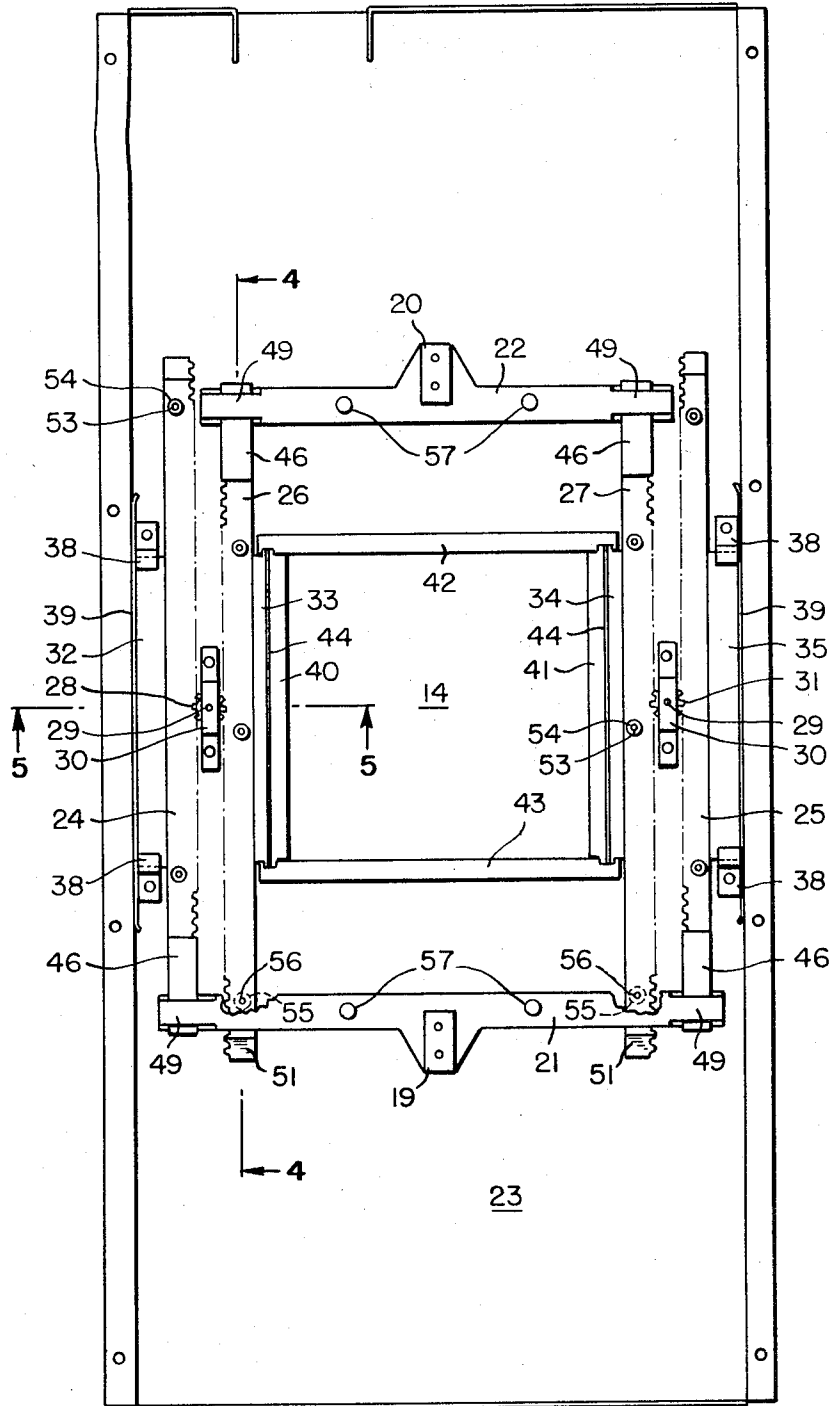


FIG. 2

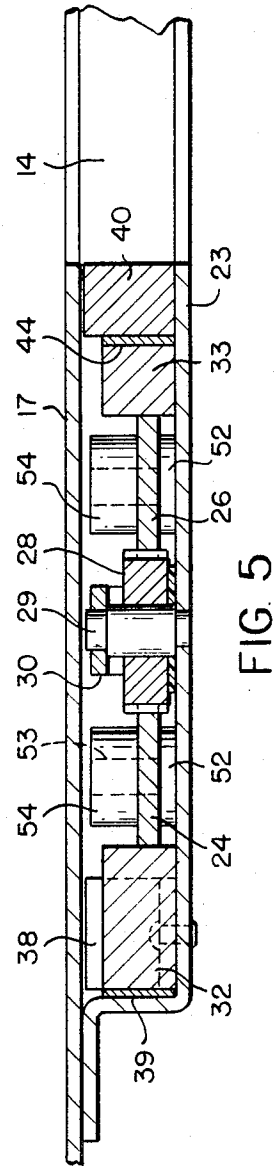
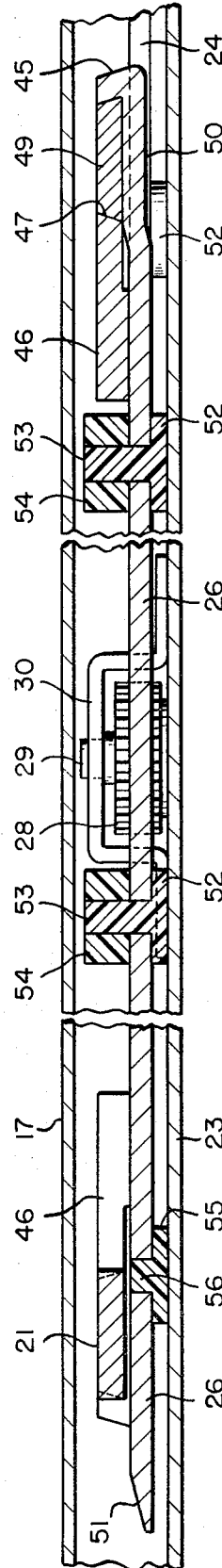
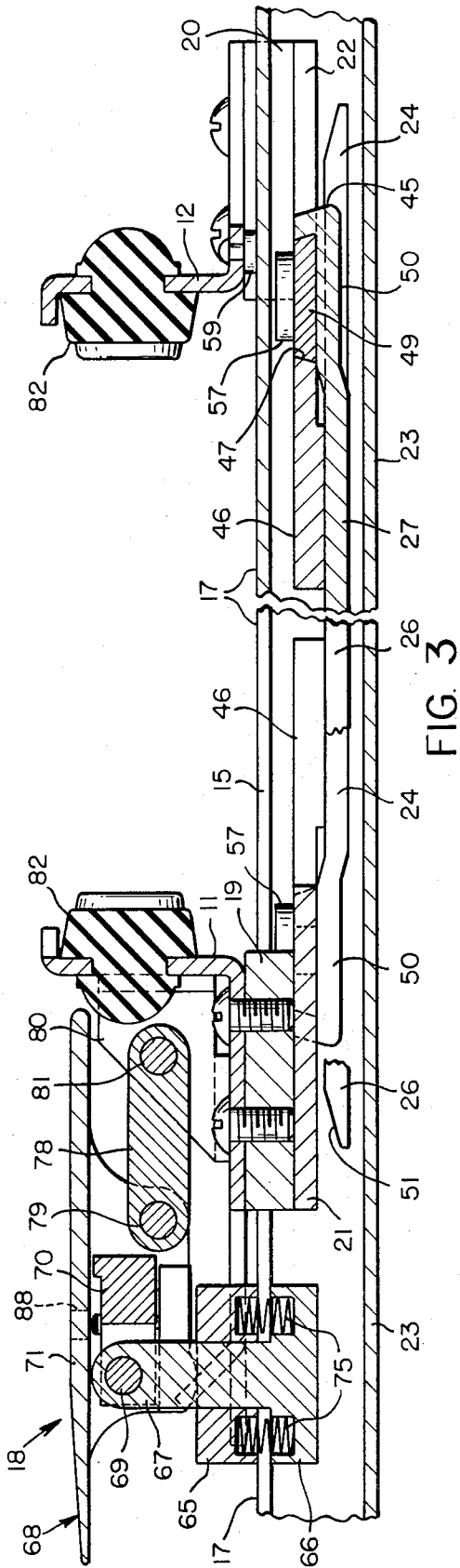


FIG. 6

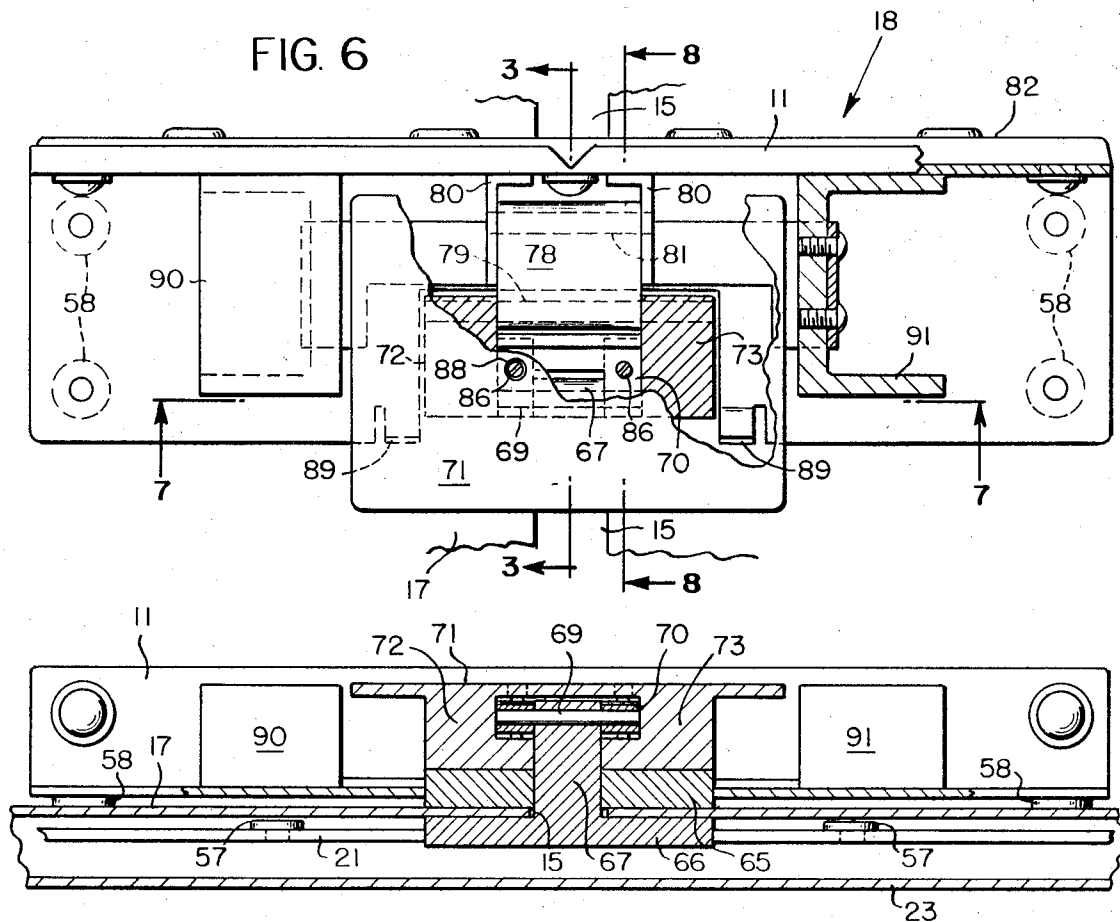


FIG. 7

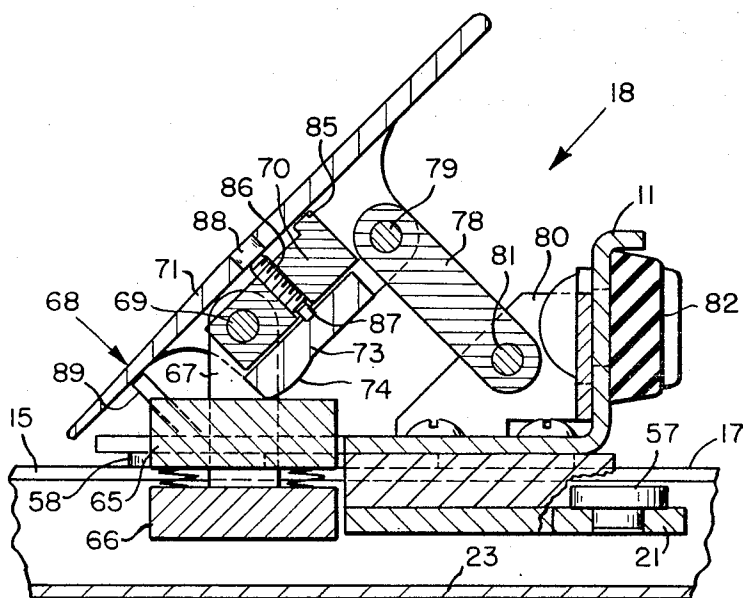


FIG. 8

X-RAY CASSETTE HOLDER

BACKGROUND OF THE INVENTION

This invention relates generally to a support and more particularly to apparatus for supporting an x-ray cassette in an x-ray system.

The film, paper, plate or other x-ray sensitive material for medical diagnostic x-rays is customarily mounted in a film holder, called a cassette, which is then mounted on a cassette holder such as a flat tray. This tray is in turn positioned in a Bucky diaphragm or some similar carriage located in a system such as an x-ray table.

The trays are usually provided with centering jaws such as those shown in U.S. Pat. No. 2,097,402-Flarsheim, U.S. Pat. No. 2,989,634-Ould et al, and U.S. Pat. No. 3,581,094-Peyser et al, which automatically locate the cassette in the desired position. Usually at least one of the centering jaws is provided with a lock with which the jaws can be secured in a desired position. The trays are frequently stood on edge, as for example, when they are used in a system for taking chest x-rays of a standing patient. Thus, it is desirable to have a lock which provides means for clamping the film cassette firmly in the jaws.

In the past the centering jaws have usually been connected by pivoted arms such as the one shown in FIG. 1 of the Flarsheim patent, FIG. 6 of the Ould patent and FIG. 3 of the Peyser patent. These pivoted arms have been used because they are simple, inexpensive and take up very little room. This last consideration is important because the trays are usually inserted in Bucky diaphragms or similar carriages with relatively shallow openings. Thus, it is important that the centering mechanism be relatively compact.

One drawback of pivoted arm centering mechanisms is that the pivot points must be positioned quite precisely or the jaws will not remain parallel as they move back and forth. This problem has become more critical in recent years because it has become common practice to provide central openings, such as the ones shown in FIG. 6 of the Ould patent and FIG. 2 and 3 of the Peyser patent, in the cassette trays so that photo timing apparatus may be positioned below or behind the cassette tray in order to measure the amount of radiation hitting the film and shut the x-ray tube off automatically. As can be seen from the Ould and Peyser patents, this restricts the placement of the pivoted arms somewhat.

SUMMARY OF THE INVENTION

It is an object of this invention to provide means for connecting centering jaws on an x-ray cassette holder that will automatically maintain a desired relationship between the jaws.

Another object is to provide a centering system for an x-ray cassette holder that is easy to assemble and does not require extremely close manufacturing tolerances.

A further object is to provide an x-ray cassette tray having an improved centering mechanism, that is compact enough to be used in conventional x-ray systems.

The invention provides an x-ray cassette holder having a pair of centering jaws mounted on the holder for movement towards and away from each other. The jaws are connected by two pairs of racks laterally displaced from each other. The first pair of racks face

each other and are separated by a pinion gear which is rotatably mounted on the holder between the racks and engages each rack. Similarly, the second pair of racks face each other and are separated by a pinion gear which is rotatably mounted on the holder between these racks and engages each rack. One rack from each pair is connected to one of the centering jaws while the other rack from each pair is connected to the other centering jaw. Thus, when one of the centering jaws is moved, the other jaws moves an equal amount in the opposite direction. The two pairs of racks maintain accurate alignment of the jaws as the jaws move back and forth. The centering mechanism may be assembled easily and does not require observation of extremely close tolerances in the assembly. Preferably means are provided to accommodate for discrepancies or misalignment that arise during the manufacture or assembly of the centering mechanism.

A still further object of this invention is to provide improved means for locking the centering jaws in position. This locking means comprises upper and lower clamping members positioned above and below a plate. The lower clamping member has a shaft which extends through a slot in the plate and through the upper clamping member. The shaft is pivotally connected to a handle which is also connected through suitable linking means to one of the centering jaws. Cam means on the handle are adapted to press the upper clamping member towards the lower clamping member in order to grip the plate. Preferably, the handle is connected to the centering jaw through a link pivotally connected to both the handle and the jaw, and the cam means and the various pivotal connections are arranged so that the connecting link continues to move forward and press the centering jaw against the cassette after the clamping members have gripped the plate. Also, means may be provided for adjusting the distance between the cam means and the pivotal connection between the handle and the lower clamping member, so that the force with which the clamping members grip the plate may be adjusted.

Other objects and advantages of this invention will be apparent from the following description.

DRAWINGS

FIG. 1 is a plan view of one embodiment of this invention.

FIG. 2 is a plan view of the holder shown in FIG. 1 with the top plate removed to show the means for connecting the two centering jaw together.

FIG. 3 is a cross-sectional side view, taken along lines 3—3 of FIGS. 2 and 6.

FIG. 4 is a sectional side view taken along lines 4—4 of FIG. 2.

FIG. 5 is a sectional end view taken along lines 5—5 of FIG. 2.

FIG. 6 is an enlarged plan view of one of the centering jaws of the holder shown in the preceding figures, partially broken away to show the means for connecting the locking assembly to the centering jaw.

FIG. 7 is a partially sectioned end view of the locking assembly and centering jaw shown in FIG. 6, showing the means for connecting the lower clamping assembly to the handle.

FIG. 8 is a cross-sectional side view taken along line 8—8 of FIG. 6, but with the locking handle in the open position.

DETAILED DESCRIPTION

Referring to FIG. 1, a cassette tray 10 is provided with a pair of centering jaws 11, 12 adapted to grip a cassette 13 containing a film, paper, plate or similar x-ray sensitive material. The tray is also provided with a central opening 14, shown in dotted lines in FIG. 1, so that the tray may be used with photo timing equipment to automatically terminate an x-ray exposure. The jaws are mounted for movement along longitudinally extending slots 15, 16 in the top plate 17 of the tray. A lock assembly, referred to generally as 18, attached to the front centering jaw 11 provides means for locking the jaws in position and gripping cassette 13 securely.

Referring to FIGS. 2 and 3, the centering jaws 11 and 12 are connected to blocks 19, 20 that ride in the slots 15, 16 in the top plate. Blocks 19, 20 are welded to two laterally extending crossbars 21, 22 positioned between the top and bottom plates 17, 23 of the tray. Two longitudinally extending racks 24, 25 are attached to the front crossbar 21 and two other longitudinally extending racks 26, 27 are attached to the rear crossbar 22. Rack 26 faces rack 24, i.e. the teeth on rack 26 are on the side closest to rack 24 and the teeth on rack 24 are on the side closest to rack 26, and the two racks are separated by a pinion gear 28 that engages both racks. As best seen in FIGS. 2 and 5, pinion gear 28 is rotatably mounted to the bottom plate 23 by a post 29 and a bracket 30. Similarly, racks 25 and 27 face each other and are separated by a second pinion gear 31, also rotatably mounted on the bottom plate, which engages these two racks. Thus, the centering jaws 11, 12 are connected to each other by the crossbars 21, 22 and by two pairs of racks which are laterally displaced from each other. Since the relative motion between the two jaws depends upon the spacing of the teeth on the racks, which can be controlled quite accurately during the manufacturing process, instead of upon the precise location of one or more pivot points, it is easier to maintain accurate alignment of the jaws with this system.

Referring to FIGS. 2 and 5, alignment of the racks with each other is maintained by four guide blocks 32, 33, 34, and 35 positioned between the top and bottom plates 17, 23. These guide blocks define channels within which the racks move longitudinally. The guide blocks are preferably made of a low friction material such as polytetrafluoroethylene. The outer guide blocks 32, 35, are loosely positioned by brackets 38 at each end of the blocks and the position of these guide blocks can be adjusted by placing shims 39 behind the blocks. Similarly the inner guide blocks 33, 34 are loosely positioned by four frame members 40, 41, 42, 43 secured to the bottom plate 23. These frame members also define the central opening 14 which, as was mentioned above, is provided so that the tray may be used with photo timing equipment. Shims 44 may be placed between frame member 40 and guide block 33 and between frame member 41 and guide block 34 in order to adjust the position of these guide blocks. Thus, the amount of play between the racks and pinion gears may be adjusted easily and accurately.

Another feature which makes it easy to assemble this system and helps compensate for manufacturing discrepancies is the use of dovetail joints connecting the racks to the crossbars. As may be seen in FIGS. 3 and

4, one end 45 of each rack is bent upwardly and inwardly and a block 46 with a slanted end 47 is welded to the rack. The up-turned end 45 of the rack and the slanted end 47 of block 46 define a trapezoidal slot at one end of each rack. The ends 49 of crossbars 21, 22 are machined so that these ends have trapezoidal cross-sections. The trapezoidal ends of the crossbars are inserted in the trapezoidal slots at the ends of the racks.

These dovetail connections between the racks and the ends of the crossbars serve several functions. They are easily assembled, and since the racks can move laterally along the trapezoidal ends of the crossbars, these joints will compensate for any misalignment of the racks. In addition the connections do not consume very much space. As was mentioned above, trays of this sort are commonly used in Bucky diaphragms or similar carriages which have shallow openings. Thus, it is important that the space between the top plate 17 and the bottom plate 23 be kept to the minimum so that the tray can be used in conventional systems. The use of these dovetail connections is one of several features that help achieve that goal.

As can also be seen in FIGS. 3 and 4, the ends of the racks which are connected to the crossbars are bent to provide offset portions 50 which raise the crossbars slightly above the rest of the racks. The other end 51 of each rack is tapered. The tapered ends and offsets help to insure that the inner racks 26, 27 will slip smoothly under the front crossbar 21 as they move back and forth in the limited space between the two plates 17, 23.

Another feature which contributes to smooth operation of the various components of this system and which helps minimize the amount of space required between the top and bottom plates is the use of a number of low friction bearing members, which are preferably made of polytetrafluoroethylene, to maintain vertical spacing of the components. As may be seen in FIGS. 2 and 4, the racks are positioned by a number of bearing members having enlarged lower pads 52, which hold the racks above the bottom plate 23, and posts 53 which extend through the racks and through annular upper bearing members 54. The upper bearing members hold the racks below the top plate and also hold the free ends 51 of the inner racks 26, 27 below the front crossbar 21. Bearing members having similar enlarged pads 55, but with shorter posts 56 which just extend through the racks are provided at the ends 51 of the inner racks 26, 27 which slip under the front crossbar 21.

As may best be seen in FIGS. 2 and 8, similar bearing members 57 keep the crossbars from rubbing against the top plate. Further bearing members 58, 59, which appear in FIGS. 3, 6 and 7, keep the centering jaws from rubbing against the top plate. Thus, the various moving components of the centering system are accurately positioned vertically without consuming a great deal of vertical space and, because of the low friction surfaces provided by the various bearing pads, these components move smoothly and easily.

When the cassette is in position and the centering jaws have been moved into place, the locking assembly 18 is utilized to grip the cassette securely. Referring to FIGS. 3, 7 and 8, the locking assembly includes an upper clamping member 65 positioned above the top plate 17 and over the slot 15 along which the front centering jaw 11 moves. This member cooperates with a

lower clamping member that has an enlarged end 66 positioned below the top plate and a central shaft 67 extending through the slot 15 in the top plate and through the upper clamping member 65. Shaft 67 is pivotally connected to a handle 68 by a pin 69 extending through a U-shaped adjusting block 70. The adjusting block is positioned between the top 71 of the handle 68 and two L-shaped members 72, 73 that depend from the top 71 of the handle. Cam surfaces 74, best seen in FIG. 8, are provided on the bottom of the L-shaped members 72, 73. When the handle is pivoted from the position shown in FIG. 8 to the position shown in FIG. 3, these cam surfaces press the upper clamping member 65 towards the enlarged end 66 of the lower clamping member, whereby the top plate 17 is gripped between the two clamping members. When the lock assembly is open, i.e. when it is in the position shown in FIG. 8, springs 75, best seen in FIG. 3, which extend from two generally cylindrical recesses in the upper clamping member into two similar recesses in the enlarged end of the lower clamping member force the two clamping members apart and help prevent accidental binding of the lock assembly.

Handle 68 is connected to the front centering jaw 11 by a linking member 78, one end of which is connected to the handle by a pivot pin 79 and the other end of which is connected to a pair of brackets 80 on the front centering jaw by another pivot pin 81. The various pivotal connections and the cam surfaces 74 on the handle are arranged so that the cam surfaces press the clamping members into gripping engagement with the top plate before the three pivot pins are coplanar, i.e. before the axes of the three pins lie in the same plane. As a result, the linking member continues to press the centering jaw forward after the clamping members have gripped the plate and thereby increases the force which the jaws exert on the cassette. Preferably, part of this forward motion of the centering jaws is absorbed by one or more deformable elements such as elastomeric pads 82 on the centering jaws. These pads also help to insure a secure grip on the cassette.

As was mentioned above, the shaft 67 of the lower clamping member is connected to the handle 68 of the locking assembly through a U-shaped adjusting block 70 positioned between the top 71 of the handle and two depending L-shaped members 72, 73. As can best be seen in FIG. 8, block 70 can be used to adjust the distance between the pivot pin 69 which connects the handle to the lower clamping member and the cam surfaces 74 on the L-shaped members. A raised strip 85 is provided along the upper front edge of the adjusting block and the adjusting block may be pivoted about this strip by two adjusting screws 86 which extend through the adjusting block into recesses 87 in the L-shaped members. Screws 86 and recesses 87 also serve to hold the adjusting block between the top of the handle and the L-shaped members.

Screws 86 are adjusted through two holes 88 in the top of the handle. By adjusting these screws, the gap between the end of the adjusting block through which the pivot 69 passes and the L-shaped members on the handle may be opened or closed, thereby increasing or decreasing the distance between the pivot pin 69 and cam surfaces 74. In this manner the force with which the clamping members grip the top plate can be adjusted. If desired, the gripping force can be set so that, if the centering jaws 11, 12 are exerting the desired

amount of force on the cassette while the handle is still partially open, the clamping members will slip along the top plate to absorb the rest of the movement of the linking member 78.

As is best seen in FIG. 3, when the handle is closed, the axis of the pivot pin 79 that connects the linking member to the handle has moved past the plane that passes through the axes of the other two pivot pins 69, 81. This provides an over center latch that holds the locking assembly shut. This over center feature cooperates with the brackets 80 on the centering jaw to maintain the handle in the desired position when the locking assembly is closed. The upper edges of the brackets limit the rotation of the top of the handle and hold it substantially level so that the rear end of the handle can not come up to the point where it might jam against the inside of a Bucky diaphragm or similar carriage.

Most are also provided for limiting the movement of the handle in the opposite direction. As may be seen in FIGS. 6 and 8, two ears 89 extend upwardly from the rear of the front centering jaw and the handle strikes these ears when the locking assembly is opened. This prevents the handle from being opened to the point where it would dig into the top plate 17 and also helps to keep the clamping members from binding when the centering jaw is moved away from the cassette.

The front centering jaw is also provided with hand grips 90, 91, mounted on either side of the handle of the locking assembly, which facilitate handling of the tray. They provide hand holds which enable the operator to hold the tray and operate the locking assembly with one hand while he handles the cassette with another. These features are particularly desirable when the holder is used in a vertical position, as would be the case in a system for taking chest x-rays of a standing patient.

From the foregoing it can be seen that this invention provides an improved means for centering and securing an x-ray cassette in a holder. Of course the tray described above is but one example of many cassette holders in which this invention may be utilized. The foregoing description is merely illustrative and is not intended to limit the scope of this invention, which is defined by the appended claims.

We claim:

1. In an x-ray cassette holder having a pair of centering jaws mounted on the holder for movement towards and away from each other, the improvement comprising:

- a. a first pair of racks facing each other with a pinion gear rotatably mounted on the holder between the racks and engaging each rack;
- b. a second pair of racks facing each other with a pinion gear rotatably mounted on the holder between the racks and engaging each rack, said second pair of racks being laterally displaced from the first pair of racks; and
- c. means for connecting one of the first pair of racks and one of the second pair of racks to one of the centering jaws, and means for connecting the other rack from each pair to the other jaw, whereby when one of the jaws is moved the other jaw automatically moves an equal amount in the opposite direction.

2. The improvement according to claim 1 wherein the means for connecting the racks to the jaws comprises a first crossbar attached to one of the centering

jaws and a second crossbar attached to the other centering jaw, said racks being connected to the ends of said crossbars by dovetail joints, whereby the racks can move laterally along said crossbars to compensate for misalignment of the racks.

3. An x-ray cassette tray comprising:

- a. a top plate having a first longitudinally extending slot in one end of the plate and a second longitudinally extending slot in the other end of the plate;
 - b. first and second centering jaws positioned above said plate and secured respectively through said first and second slots to first and second laterally extending crossbars, said crossbars being positioned between said top plate and a bottom plate extending generally parallel to said top plate;
 - c. first and second longitudinally extending racks attached to said first crossbar and laterally displaced from each other;
 - d. third and fourth longitudinally extending racks attached to said second cross bar, with said third rack facing said first rack and said fourth rack facing said second rack; and
 - e. a first pinion gear rotatably mounted to the holder between and engaging said first and third racks, and a second pinion gear rotatably mounted to the holder between and engaging said second and fourth racks, whereby when one of the centering jaws is moved the other jaw automatically moves an equal amount in the opposite direction.
4. A tray according to claim 3 wherein the ends of the crossbars have trapezoidal cross-sections, one end of each rack defines a trapezoidal slot, and the trapezoidal ends of the crossbars are inserted in said trapezoidal slots, whereby the racks can move laterally along the crossbars to compensate for misalignment of the racks.
5. A tray according to claim 3 further comprising guide blocks positioned between said top and said bottom plates and defining channels within which said racks move longitudinally, said guide blocks being loosely positioned between said plates so that shims may be placed behind the blocks to adjust the amount of play between the racks and the pinion gears.
6. In an x-ray cassette holder having a pair of centering jaws mounted on the holder for movement toward and away from each other, improved means for locking the jaws in position comprising:
- a. an upper clamping member positioned above a slot in a plate,
 - b. a lower clamping member having an enlarged end positioned below the plate and a shaft extending through the slot and through the upper clamping member;

c. a handle pivotally connected to the shaft and cam means on the handle adapted to press the upper clamping member towards the lower clamping member, whereby the plate is gripped between the two clamping members; and

d. linking means connecting said handle to one of said centering jaws.

7. The improved locking means according to claim 6 wherein

- a. the means for linking the handle to the centering jaw comprises a member having one end pivotally connected to the jaw and the other end pivotally connected to the handle; and
- b. the cam means on the handle is adapted to press said clamping members into gripping engagement with said plate before the pivotal connection between the handle and the linking member is coplanar with the pivotal connection between the handle and the shaft of the lower gripping member and the pivotal connection between the linking member and the centering jaw, whereby the centering jaw is moved forward after the clamping members grip the plate.

8. The improved locking means according to claim 7 further comprising a deformable element adapted to absorb at least part of the forward movement of the centering jaw.

9. The improved locking means according to claim 8 wherein said deformable element comprises an elastomeric pad attached to the centering jaw.

10. The improved locking means according to claim 6 further comprising means for adjusting the distance between the cam means on the handle and the pivotal connection between the handle and the shaft on the lower gripping member.

11. The improved locking means according to claim 10 wherein;

- a. said handle comprise a top member and a pair of L-shaped members depending from the top member; and
- b. the means for adjusting the distance between the cam means and the pivotal connection comprises:
 - i. an adjusting block positioned between said top member and said L-shaped members, said pivotal connection to the shaft of the lower gripping member being made through said adjusting block; and
 - ii. adjusting screws extending through said adjusting block and bearing upon said L-shaped members.

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