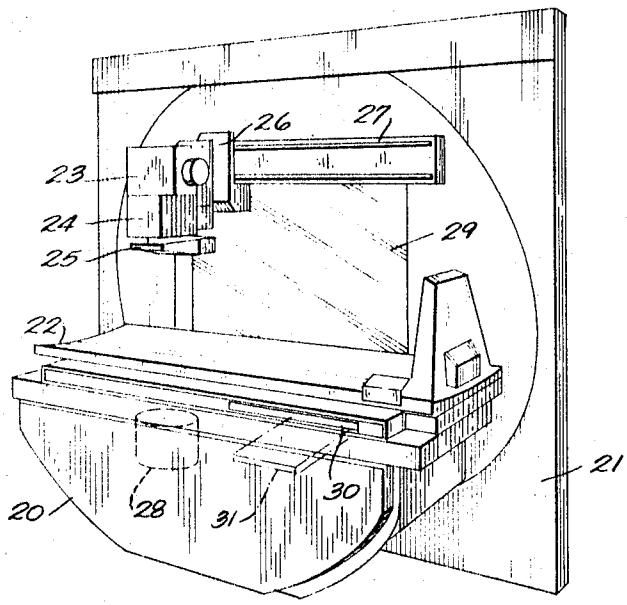
Sept. 2, 1969 R. M. KIES ET AL 3,465,144

SERIAL X-RAY CASSETTE POSITIONER

Filed July 19, 1967 5 Sheets-Sheet 1

Fig. 1



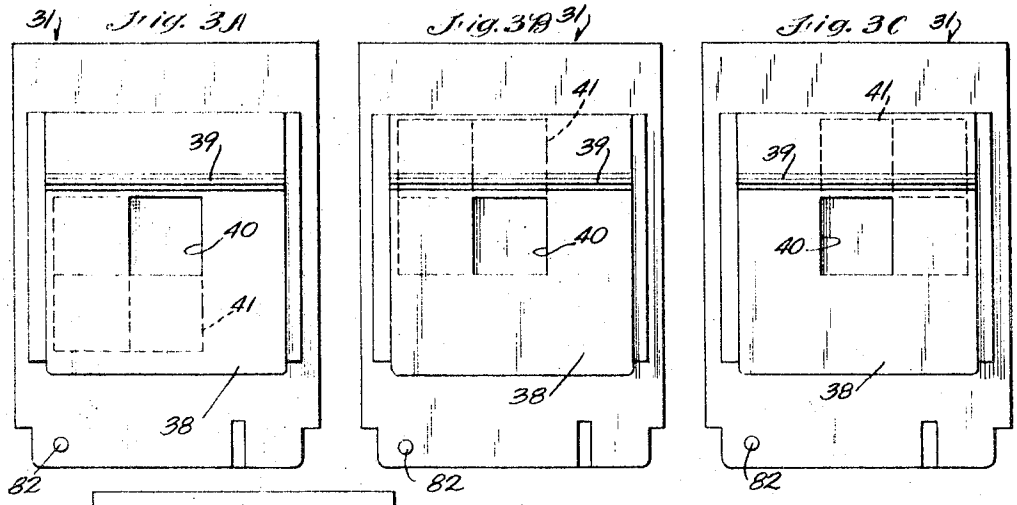


Fig. 3

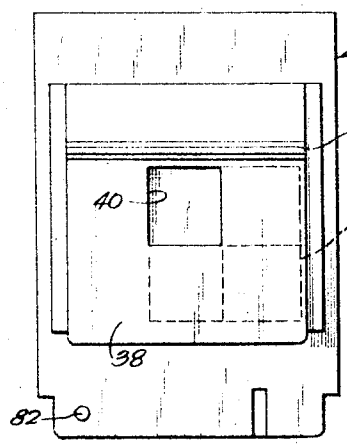


Fig. 3D

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SERIAL X-RAY CASSETTE POSITIONER

Filed July 19, 1967 5 Sheets-Sheet 2

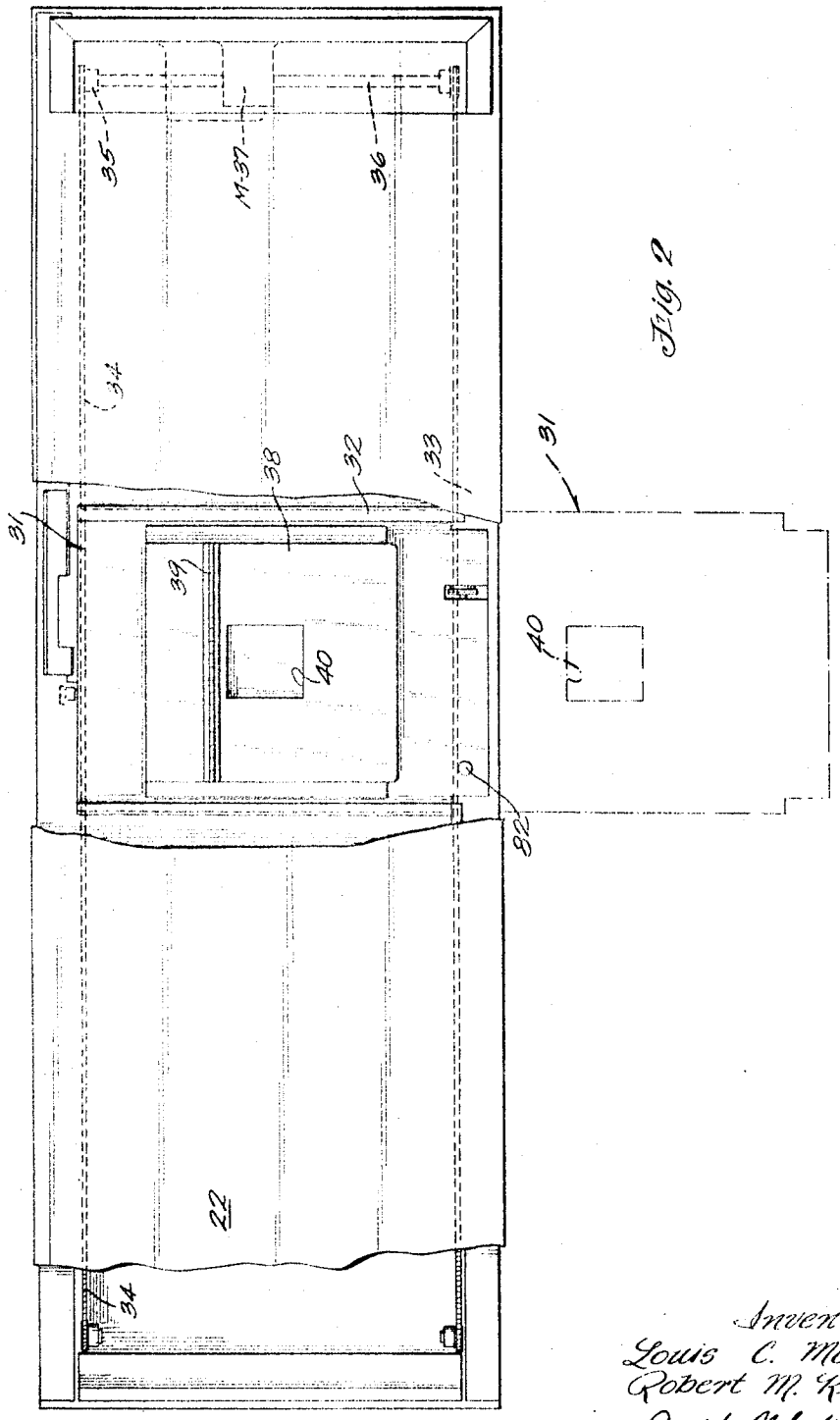


Fig. 2

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SERIAL X-RAY CASSETTE POSITIONER

Filed July 19, 1967 5 Sheets-Sheet 3

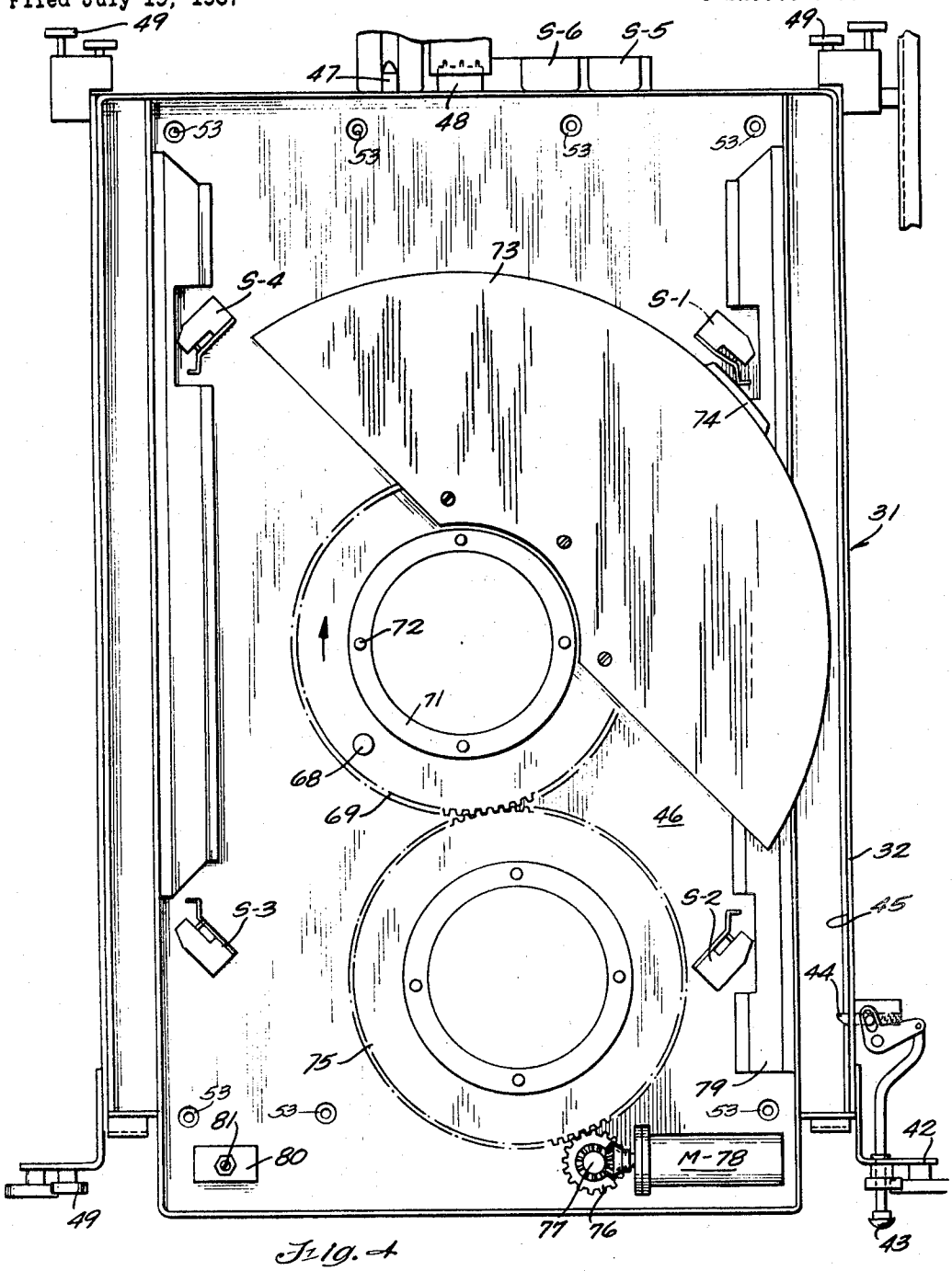


Fig. 4

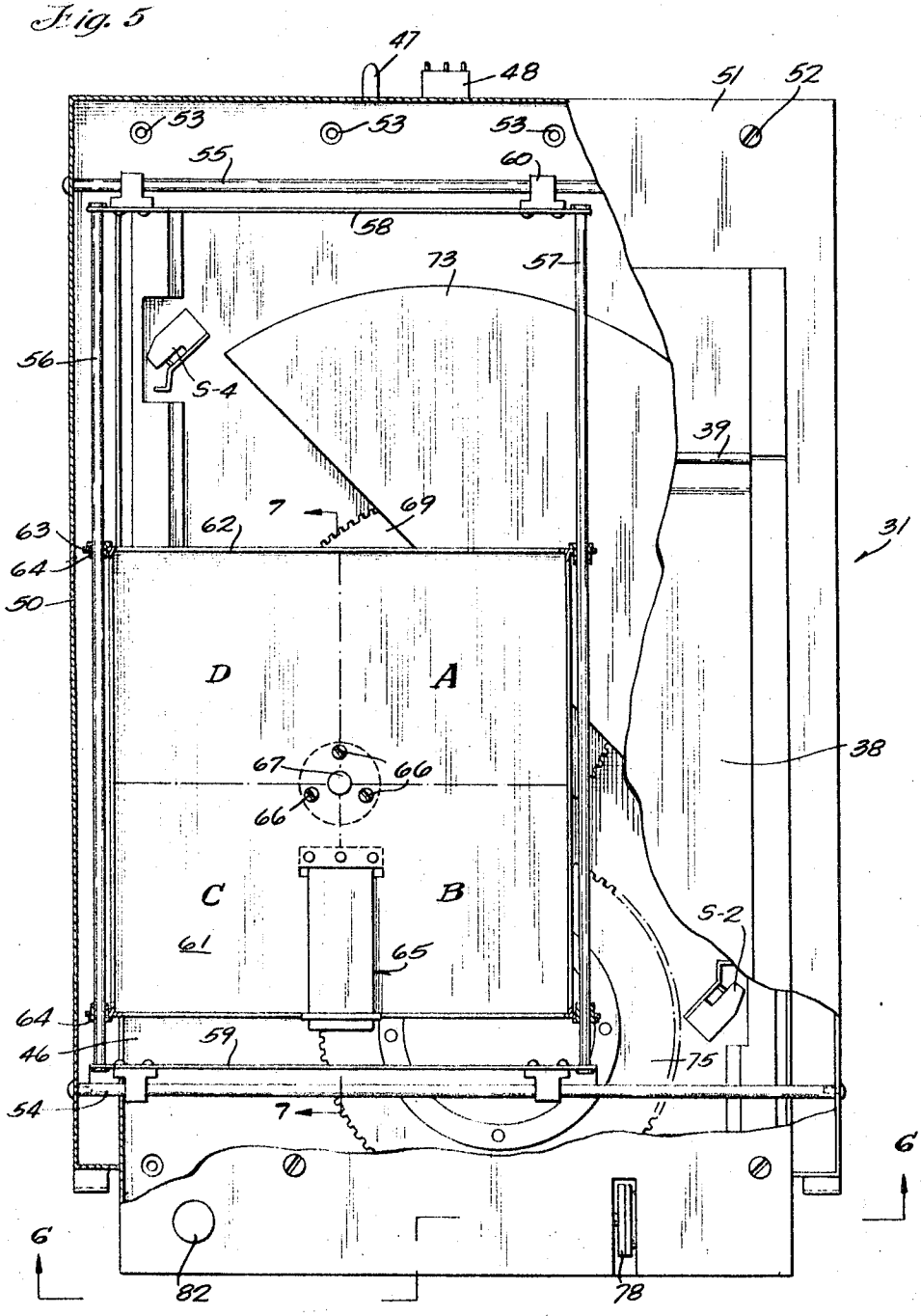
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SERIAL X-RAY CASSETTE POSITIONER

Filed July 19, 1967 5 Sheets-Sheet 4

Fig. 5



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Filed July 19, 1967 5 Sheets-Sheet 5

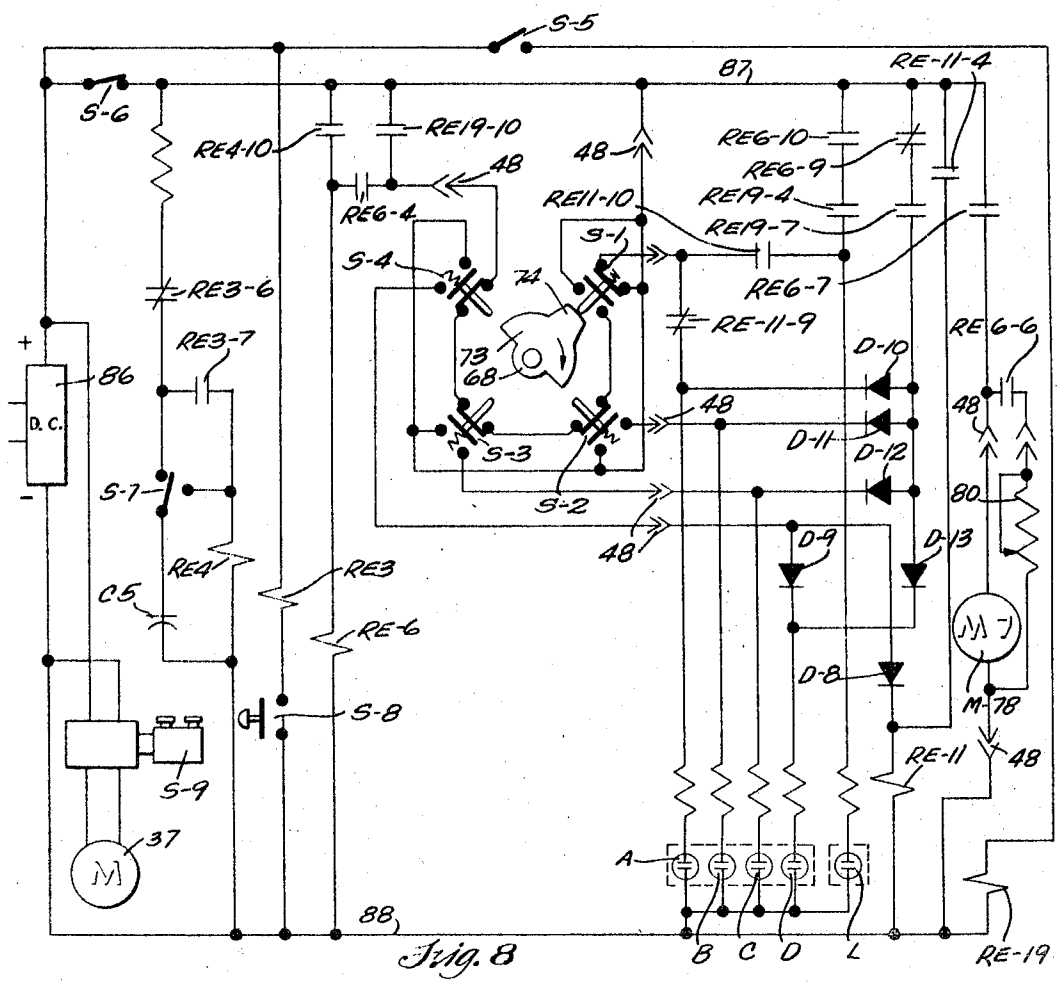
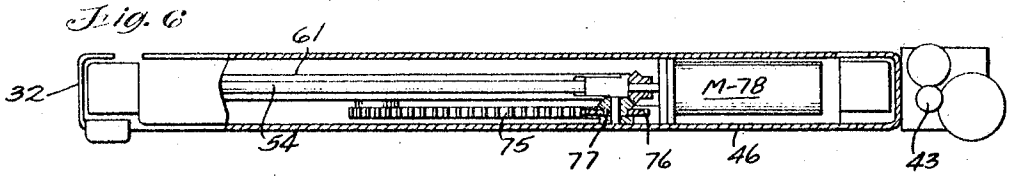


Fig. 8

Fig. 6



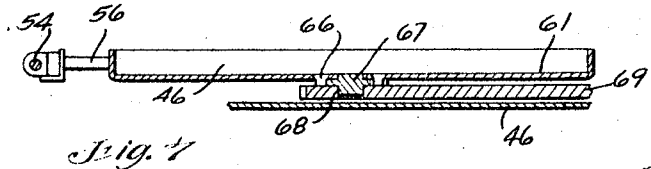


Fig. 7

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3,465,144

SERIAL X-RAY CASSETTE POSITIONER

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Filed July 19, 1967, Ser. No. 654,621
Int. Cl. G01n 23/04
U.S. Cl. 250—66 4 Claims

ABSTRACT OF THE DISCLOSURE

A unitary serial radiographic device is adapted to be carried and operated in the bucky tray which usually carries only a single radiographic cassette in an X-ray table. The bucky tray and the device may be transferred manually or automatically from parked position in the X-ray table to a position for intercepting and recording a sequence of X-ray images that are normally viewed on a television monitor by way of an image amplifier that is located in the table body.

Background of the invention

This invention related to diagnostic X-ray apparatus.

An arrangement which is becoming increasingly prevalent in X-ray tables is to support the X-ray tube over the table and form the X-ray image on an X-ray image intensifier which is built into the table body. The visible image that is produced by the intensifier is viewed by a built-in television camera which permits observing the image on a remotely located television monitor.

The image intensifier is often equipped with a cine camera for making rapid recordings of a series of X-ray images in connection with certain radiological technics. In some cases, however, the radiologist prefers a series of radiographs that need not be projected for enlargement, but are of sufficient size for direct examination on a film viewer.

A series of radiographs is obtainable with a device that is variously called a spot film or serialographic device in conventional X-ray tables. In such tables, the X-ray tube is located within the table body and the serialographic device is above the table in which case there is considerable space available to accommodate the device. However, when the X-ray tube is above the table and the image intensifier is in the table, the serialographic device must be advanced and retracted in the small space between the intensifier and the underside of the table top. The table top-to-intensifier distance must be small or the input image to the intensifier will be unduly magnified and distorted at its edges as a result of geometrical conditions inherent in producing a shadow image with a conical X-ray beam that emanates from a point source.

Because of space limitations, some prior art X-ray tables have resorted to a built-in serialographic device which comprises a film cassette tray that is supported in the bucky mechanism which, in turn, is translatable longitudinally of the X-ray table. The first of the front pair of film quadrants is exposed and then the second quadrant is exposed by shifting the cassette laterally with a separate shifting mechanism that is permanently located in the table body and is coupled to mechanism that engage the cassette. The second two quadrants are exposed in sequence by first shifting the whole bucky mechanism longitudinally of the table and then making a lateral shift with the built-in mechanism. This arrangement requires having one motor and mechanism for shifting the cassette longitudinally by way of shifting the bucky, and another motor and mechanism for shifting laterally. This arrangement increases cost, results in congestion of the parts in the table body, reduces versatility of the table, requires installation at the factory and has other disadvantages.

Summary of the invention

The present invention overcomes the above-noted problems and is characterized as a unitary and self-contained serialographic device that can be inserted in the bucky tray in the same shallow space that normally accommodates a standard film cassette.

The new device incorporates a square film cassette tray and an electric motor and mechanism for shifting the cassette tray both longitudinally and laterally. It allows making a sequence of radiographs on quadrants of the film and retains the ability of the table to make a full-size radiograph on a standard cassette if desired. The device has a connecting plug which engages a mating receptacle in the rear of the bucky trays so as to make all electrical connections when the device is simply slid into the bucky tray. Because it is only necessary to install the mating receptacle and some wiring in the table, existing X-ray tables can be readily adapted for the new serialographic device on the user's premises.

The new device has a base and an upper part which are superposed on each other to form a relatively thin rectangular box-like assembly. The base contains the motor, a gear train, a counterweight, some switches, and other parts. The upper part contains a cassette tray that is mounted on a pair of cross-shafts for bilateral shifting. A drive pin extending from the bottom of the cassette tray engages a hole in one gear of the train in the base, so that as the gears turn through angular steps on command, the cassette shifts. The counterweight serves the dual purposes of holding the cassette in balance for any tilted position of the X-ray table and operating the cassette position indicating switches. The motor is dynamically braked and the adjustment of the braking is readily made with a potentiometer that is accessible from the top of the device. An X-ray opaque cover on the device provides access for changing cassettes when the serialographic device is withdrawn and the cover has an aperture of appropriate size for exposing one quardant of the film at a time. In the illustrative embodiment, the film is exposed in quarter-sections or quadrants, but it should be understood that the device may be modified to expose fewer larger areas or more smaller areas. However, "quadrant" is used for convenience to indicate an area of exposure regardless of its size.

Although the objects of this invention are implicit in the foregoing summary, briefly, they are: to permit serialography in X-ray tables that have a bulit-in image intensfiier; to provide a new type of power driven serialographic device that can be accommodated by an existing bucky tray; to minimize the distance between the patient and the film cassette and the image intensifier; to make taking both serialographic and standard full-size films convenient; and, to achieve these ends by simple, compact, easy to use and inexpensive means.

Accomplishment of these and other more specific objects will be evident in the ensuing specification taken in conjunction with the drawings.

Description of the drawings

FIGURE 1 is a perspective view of a remotely controled X-ray table in which the new serialographic device may be used;

FIGURE 2 is a top view of the X-ray table body with parts broken away to show the location of the serialographic device within the table;

FIGURES 3A–3D are top views of the serialographic device showing the different positions of the cassette for exposure of the various film quadrants;

FIGURE 4 shows a plan view of the base of the serialographic device installed in the bucky tray, the upper part of the device being removed;

FIGURE 5 shows the upper part of the device with the X-ray opaque cover partially broken away, the assembly shown in this figure being superposed on the base shown in FIGURE 4 when the device is assembled;

FIGURE 6 is a vertical cross-section taken on a line corresponding approximately with **6—6** in FIGURE 5;

FIGURE 7 is a vertical cross-section taken on a line corresponding with **7—7** in FIGURE 5; and

FIGURE 8 is a diagram of the electric circuitry employed in the new serialographic device.

Description of the preferred embodiment

FIGURE 1 shows an X-ray table body **20** that is mounted on a concealed ring gear which is rotatably driven by any suitable mechanism, not shown. The drive mechanism is incorporated in and behind a frame **21**. This is one known construction for enabling the X-ray table body **20** to be angulated between vertical and inverted vertical positions.

The table is provided with an X-ray transmissive top **22** for supporting a subject undergoing examination. Spaced above the top is an X-ray tube casing **23**, a collimator **24**, and a palpator **25** which are attached to a carriage **26**. The carriage **26** is adapted for movement longitudinally of the X-ray table on tracks **27**. Carriage **26** is coupled mechanically, by means that are not shown, with an X-ray image intensifier **28** located within the X-ray table body. With this arrangement, the central ray of the conical X-ray beam emanating from X-ray tube casing **23**, remains centered on the top or input end of the image intensifier when the casing and intensifier are translated longitudinally of the table.

Within the rotatable table support is a lead glass window **29** behind which there is a control console, not shown. The radiologist is situated at the control console and by operating appropriate switches he may tilt the table and the patient, control the position of the X-ray tube, shift the patient laterally and longitudinally with the table top **22** and view on a television monitor the converted X-ray image which is formed by the image intensifier **28**. Also coupled to the image intensifier, but not shown, are a cine recording camera and television camera.

In FIGURE 1, at the front of the table, one may see a bucky tray access opening **30**. As is well-known, a bucky tray is adapted for being transferred from a parked position at one end of the table **20** to an active position where it aligns with the X-ray beam so that a radiograph may be made on a film which is in a standard cassette that is carried in the bucky tray. Shown in broken lines in this figure, is the new serialographic or spot-film device **31**, the drawing suggesting that the device may be inserted in the bucky tray from the front of the X-ray table to supplant a standard cassette. The bucky tray together with the serialographic device **31** may be projected into the X-ray beam to allow taking series of radiographs on the various film quadrants when the operator observes on the television monitor a condition which he would like to record permanently.

In FIGURE 2, the table top **22** is partially broken away to expose the serialographic device which is generally designated by the reference numeral **31**. The serialographic device **31** is carried in a rectangular bucky tray **32** which is mounted on rollers that cooperate with tracks **33** which are on opposite sides and extend lengthwise of the X-ray table. The bucky tray **32** is attached between the ends of a chain **34** in order to translate the tray rotation of sprockets **35**. The sprockets are at the opposite ends of a shaft **36** which is driven by a motor M–**37** and speed reducer. When the motor M–**37** is energized on command, the bucky tray **32** and serialographic device **31** are projected from a parked position at one end of the table to a position that aligns the center of the serialographic device **31** with the central ray of the X-ray beam which is projected through the table top. Of course, means are provided, but not shown, for stopping the bucky tray when alignment of X-ray tube **23** and image intensifier **28** is achieved. The broken line outline of serialographic device **31** in FIGURE 2 suggests how the device may be withdrawn from the bucky tray through the front access opening **30** under the X-ray table top **22**. It may be observed in FIGURE 2 that the serialographic device **31** is provided with a cover **38** which is hinged at **39** so that when the device is withdrawn, the cover may be swung upwardly to exchange film cassettes in the device. Cover **38** is X-ray opaque except for a central square opening **40** for admitting the X-ray image to a film cassette which lies below it.

Before discussing the structural details of the new serialographic device, reference may be made to FIGURE 3 for a review of its general operating mode. Within serialographic device **31** is a square cassette **41** shown in outline beneath cover **38**. When the cassette is first loaded into the device, quadrant A is aligned with aperture **40** in the cover as shown in FIGURE 3A. After this area is exposed, manually or automatically controlled cassette transfer results in cassette **41** being shifted as shown in FIGURE 3B in which case quadrant B is ready for exposure. Then quadrants C and D are made ready consecutively as shown in FIGURES 3C and 3D, respectively. As will be explained later, the operator has the option of restoring the bucky tray to parked position at the end of the X-ray table after each quadrant is exposed or the serialographic device and tray may remain in transferred position whereupon the sequence of radiographs may be taken before going back to parked position for reloading the cassette.

Refer now to FIGURE 4 which shows the bottom or base **46** of the serialographic device with its top removed and installed in the bucky tray **32**. Base **46** is a substantially planar sheet metal part with upstanding edges. The bucky tray carries on a bracket **42** a plunger **43** which allows advancement and retraction of a detent pin **44**. This pin releasably extends through the side wall **45** of the tray-like base **46** to secure the device in the bucky. The bucky tray **32** is carried on rollers **49** which cooperate with tracks **33** that were mentioned in connection with FIGURE 2. Extending from the rear wall of the serialographic device base **46** is an index pin **47** which compels reproducible location of the serialographic device in the bucky tray each time the device is inserted. Also at the rear end of the base **46** is an electrical connector **48** which effects all of the electrical connections between the fixed table structure and the serialographic device when the device is inserted in the bucky tray. Thus, when the serialographic device **31** is removed from the bucky tray **22**, electrical connections are severed and a standard cassette may be inserted in place of device **31**.

Before detailing the construction of the driving mechanism of the serialographic device which is located in its base **46** as shown in FIGURE 4, the construction of the upper assembly which includes the driven part of the device will be examined in connection with FIGURE 5. One may see that the upper assembly comprises a frame **50** which overhangs the base **46**. A top plate **51** which supports cassette access cover **38** also supports the mechanism in the upper portion of the serialographic device. The upper plate **51** is held in proper spaced relationship with the base assembly by means of screws **52** that thread into spacer posts **53** which are located in various places in the base **46**.

Fixed guide means which in this embodiment constitute a pair of parallel stationary shafts **54** and **55** extend across the front and rear of the serialographic de-

vice. Another guide means constituting a pair of shafts **56** and **57** are parallel with each other and extend lengthwise of the serialographic device and transversely of the X-ray table when the device is installed. The pair of shafts **56**, **57** are connected at their ends by bars **58** and **59**. The frame created by shafts **56**, **57** and bars **58**, **59** is supported on four nylon bearing guides **60** which pass over stationary shafts **54**, **55**. Thus, the frame may be shifted reversibly sidewise on rods **54** and **55**.

Supported on the transverse shafts **56**, **57** is a cassette tray **61** with upstanding edges **62** and extensions **63** which have nylon bearing inserts **64** so the tray **61** may slide on shafts **56**, **57**. A square cassette for the serialographic device is normally accommodated by cassette tray **61** but is omitted from FIGURE 5. The letters A–D indicate the quadrant in the tray over which a corresponding quadrant of film would be superimposed if there were a cassette in tray **61**.

From the description thus far, one may see that cassette tray **61** is adapted for bilateral movement in a single plane in parallel with the base of the serialographic device and table top. The cassette tray is shifted bilaterally by engaging a flanged pin **67** which extends from the bottom of the tray and is secured to the tray **61** from its top by three screws **66**. FIGURE 7 illustrates how the downwardly extending portion of the pin **67** is engaged in a hole **68** which is in a rotatable driving element in the form of gear **69**. Gear **69** constitutes part of the cassette tray driving mechanism and is supported in the base **46**. Gear **69** acts like a crank for cassette shifting because of hole **68** being displaced radially from the rotational axis of the gear.

FIGURE 5 shows a thin pliable strip **65** of Mylar or the like lying in the bottom of cassette tray **61**. One end of strip **65** passes through a slot in the tray so that the end may be clamped with three screws and a strap. The free end of strip **65** extends through a slot in an upstanding side wall of tray **61**. The operator may grasp the free end and lift or put tension on the strip in order to lift a cassette partially from tray **61** for reloading.

In reference to FIGURE 4, gear **69** is relatively thin and is supported for rotation on a stationary bearing ring **71** which is secured with screws **72**. Gear **69** has attached to it a flat semicircular counterweight **73** whose outer margin has a cam riser **74** which operates switches S–**1** to S–**4** as the cassette position changes. The center of mass of counterweight **73** is diametrically opposite hole **68** in gear **69** so that when pin **67** is engaged, the driven mechanism, primarily the cassette tray, is suitably counterweighted. Thus, regardless of the attitude of the X-ray table, the cassette tray does not tend to shift unless it is driven.

When gear **69** rotates and hole **68** orbits, cassette tray **61** will consecutively position quadrants A through D under aperture **40** in cover **38** of the serialographic device as a result of tray **61** being translated by shifting of pin **67**.

Meshed with gear **69** is a similarly journaled gear **75**. The latter is driven by a miter gear train **76** which has one of its gears journaled on a shaft **77** that is fastened to base **46**, as clearly seen in FIGURE 6. Of course, a series of pulleys and belts might be substituted for the gear train between the motor and cassette tray as long as there is some means for detachably coupling the last rotating element in the train with the cassette tray.

The train of gears thus far described is driven by an electric cassette transfer motor M–**78** which is mounted in the base **46** of the serialographic device. The motor is supplied through wiring which is not shown in FIGURE 4, but passes under wire ducts **79** which accommodate other wires too.

Also in base **46**, as shown in FIGURE 4, are four microswitches S–**1** to S–**4**, which are limit switches and are operated consecutively by cam riser **74** on the counterweight as the counterweight **73** orbits clockwise and as the cassette reaches its various positions for exposure of a film quadrant. The function of switches S–**1** to S–**4** will be described in detail later along with the description of the electrical circuitry and operating mode in reference to the circuit diagram, FIGURE 8.

In base **46**, see FIGURE 4, is a potentiometer **80** with an adjusting screw **81**. As can be seen in FIGURE 5, access for adjustment can be obtained by removal of a snap insert **82** from the cover. Potentiometer **80** is in the dynamic braking circuit of cassette transfer motor M–**78** and it requires initial adjustment so that the cassette tray will stop in the same position when the motor is de-energized following a driving cycle.

In FIGURE 4, note that attached to the rear of the bucky tray are two additional switches S–**6** and S–**5**. Switch S–**6** is closed when either a standard cassette or the new serialographic device are in the bucky tray. Switch S–**5** is closed only when a standard 14 x 17 inch cassette is substituted in the bucky tray for the serialographic device.

As a brief review of the construction and operating mode of the device, we observe that when motor M–**78** is energized for an interval which is self-terminating, gear **69** will rotate and cause hole **68** to orbit through an angle of 90°. This action causes cassette tray **61** to shift until the center of quadrant B coincides with the center of the aperture **40** in the serialographic device cover **38**. The shift is terminated by cam riser **74** reaching switch S–**2** in the base of the device in which case conditions are set for exposing the next film quadrant. Hole **68** is then repeatedly caused to orbit in ninety degree steps until cam riser **74** operates switch S–**4** to condition the device for exposure of the last film quadrant D.

Relative to describing the electrical circuitry in connection with FIGURE 8, we may observe that the new serialographic device may be operated in manual and automatic modes. Manual is defined to mean that the bucky and serialographic device will be transferred from parked position into the X-ray beam path, whereupon the cassette will be advanced until it is fully exposed by consecutively pressing manual switch S–**8**. Automatic is defined to mean that the bucky tray and serialographic device are projected into the beam path, whereupon exposure of one quadrant is made and then the device is returned to parked position where the cassette is advanced automatically to a state of readiness for exposing the next quadrant.

The serialographic device may be transferred from parked position to active position, and vice versa, by pressing a pushbutton switch S–**9** which is located in the control console behind window **29**. Through suitable controls, this energizes motor M–**37** as seen in FIGURES 8 and 2 for transferring the bucky tray by means of the chain drive mechanism.

The electrical circuitry establishes that when a cassette is loaded in tray **61**, quadrant A will be ready for first exposure and indicating lamp A, see FIG. 8, will be lit to indicate the state of readiness. There are a series of indicating lamps A–D which go on to indicate that a corresponding quadrant is ready for exposure and go off after exposure. When all quadrants are exposed, a load lamp L lights indicating that cassette reloading is required.

In FIGURE 8 the chevron-shaped marks in certain of the conductors indicate a connection that is made between the bucky tray and the serialographic device through connector **48** which is carried by the device.

In connection with describing the circuit diagram of FIGURE 8, relays will be designated with a number preceded by RE, such as, RE–**6**. Contacts operated by a relay will be designated by the associated relay number followed by a contact number, such as, RE**6**–**10**. Non-relay type switches will be designated by a number preceded by the letter S, such as, S–**8**. Diodes will be designated by a number preceded by a letter D, such as, D–**8**.

Assume that the serialographic device is to be operated in the manual mode and has been loaded with an unexposed film cassette. When the radiologist desires to make an exposure, he presses pushbutton switch S–9 at the console to operate motor M–37 and thereby transfer the bucky tray and serialographic device from parked to active position in the X-ray beam. At this time the circuit elements are in the state shown in FIGURE 8. Switch S–6 is closed to apply power from D-C source 86 to positive line 87 and negative line 88. Indicator lamp A is lit by reason of there being a completed series circuit from line 87, through the closed cam operated radially outward or outside contacts of microswitch S–1, contact RE11–9, lamp A and to the negative line 88. Note that all the outside contacts of S–1 to S–4 control the state of the indicator lamps and that the inside contacts of these same switches control relay RE–6, which determines whether cassette transfer motor M–78 is or is not energized.

When indicator lamp A is on, the device is in a state of readiness for exposing quadrant A. The operator presses pushbutton switch S–9 in the console to energize motor M–37 and transfer the bucky and device to the x-ray beam path as mentioned above. During this time, capacitor C–5 is charged through RE3–6 and S–7. After an exposure is made, the operator presses S–8 to energize RE–3. RE3–7 contacts close and capacitor C–5 discharges through RE–4. Closure of RE4–10 contacts energizes RE–6. RE6–4 contacts close to lock in RE–6. Lock-in results from the fact that when RE–6 is energized, cassette transfer motor M–78 begins operating and causes the counterweight and cam 74 to rotate. This allows the inside contacts of microswitch S–1 to close and complete the lock-in circuit through the inside contacts of the other microswitches S–2, S–3 and S–4 through RE6–4.

Cassette transfer motor M–78 continues to run until cam 74 actuates S–2. Upon this event, the outside contacts of S–2 close to complete the circuit to indicator lamp B. During the motor running interval, contacts RE6–6 are open and RE6–7 are closed to provide power to motor M–78. When the inside contacts of S–2 open, RE6–7 open and RE6–6 close for the latter to shunt potentiometer 80 across motor M–78 for dynamic braking. This terminates cassette transfer and places the device in readiness for exposure of quadrant B. A precise stopping point for the motor is established by adjustment of potentiometer 80 and, accordingly, the amount of dynamic braking.

After exposure of quadrant B, the same sequence of events is initiated by the operator pressing S–8 in the console. Microswitch S–3 then operates, lamp C lights and quadrant C is ready for exposure.

After quadrant C is exposed, S–8 is again pressed and M–78 drives until cam 74 actuates S–4. The outside contacts of S–4 close and cause indicator lamp D to light. Then exposure of quadrant D may be made. The bucky and serialographic device may then be returned to parked position for reloading by pressing pushbutton S–9.

Note that when switch S–4 was actuated by the cam 74, the outside contacts of S–4 closed to light indicating lamp D through diode D–9. At the same time, power is applied to diode D–8 to energize relay RE–11. When RE–11 is energized, its RE11–4 contact in series with it closes and locks RE–11 in. At the same time, normally closed contacts RE11–9 open, to assure that indicator lamp A will not light, and RE11–10 close. In reality, at this time, lamp A would not light because the outside contacts of S–1 are open.

When the bucky returns to the park and load position, a momentary contact switch S–7 is actuated to discharge capacitor C–5 through RE–4. This is equivalent to starting an operational sequence by pressing S–8. In any event, cassette transfer motor M–78 runs and cam 74 is restored to its initial position in FIGURE 8 whereupon the outside contacts of S–1 close again. Load indicator lamp L then lights by reason of there being a complete series circuit from line 87 through the outside contact of S–1, closed contact RE11–10 and lamp L to the opposite side of the line 88.

When the serialographic device is withdrawn from the bucky tray through the access opening 30 in the X-ray table for exchanging cassettes, all electric power is removed from the device. This causes RE–11 to de-energize and drop out its holding contact RE11–4. At the same time, RE11–9 closes and RE11–10 opens to render the circuit through the load lamp L incomplete. When, after loading, the serialographic device is reconnected through connector 38 and with RE11–9 being normally closed, lamp A is lit and with RE11–10 being normally open, lamp L is out.

During automatic operation of the serialographic device, the electrical circuitry functions similarly to the manner just described in connection with manual operation. However, in automatic operation, the cassette changes positions automatically following an exposure and return of the bucky tray to parked position. When the bucky tray is driven back to parked position, it operates momentary switch S–7 to discharge capacitor C–5 through RE–4. Motor 78 then operates to advance the cassette to the next quadrant as described earlier.

When the serialographic device is removed from the bucky tray, a standard 14 x 17 inch cassette may be substituted for it. Removal of the serialographic device removes the following components from the circuit of FIGURE 8: switches S–1—S–4, motor M–78, and potentiometer 80 together with the wiring from these elements to connector 48. The integrity of the other circuitry remains since this circuitry is installed outside of the bucky tray.

Insertion of a standard cassette causes closure of switches S–5 and S–6 which are at the back of the bucky tray. Closure of S–5 energizes RE–19 and closure of S–6 causes all indicator lamps A–D to light since the lamps are now supplied from line 87 through RE6–9 and RE19–7 and individual diodes D–10—D–13. Contacts RE19–7 are closed at this time by reason of RE–19 being energized following closure of S–5. Load lamp L is extinguished because RE6–10 contacts are open.

When the standard cassette is transferred by means of the bucky into the X-ray beam, an exposure may be taken. Transfer is effected by pressing console switch S–9. After exposure, the bucky is returned to parked position. This causes momentary switch S–7 to discharge C–5 through RE–4. RE4–10 contact then closes to energize RE–6. RE–6 locks in by reason of RE19–10 and RE6–4 being closed. RE6–10 also closes at this time and since RE19–4 is already closed, load lamp L lights. The cassette is then withdrawn from the bucky tray and another one substituted.

When the exposed cassette is removed, S–6 opens. This de-energizes relay RE–6 and opens RE6–10. RE19–4 is already open by reason of S–5 having opened and de-energized RE–19 so that lamp L is extinguished. The new cassette closes S–5 and S–6 again so that all the indicator lamps except the load lamp L go on, whereupon the apparatus is again readied for taking another full size radiograph on command of the operator.

In summary, a new serialographic device has been described which permits taking a sequence of radiographs although the image intensifier is located inside the X-ray table. The device is self-contained and includes the drive mechanism and associated parts. It is insertable in the bucky tray without adversely affecting the focal-spot-to-film or focal-spot-to-image-intensifier distances. The device positions the film cassette both longitudinally and laterally of the table. It affords the convenience of taking both serialographs and standard radiographs in one X-ray table. The device is readily adapted to existing X-ray tables because it is accommodated by the bucky tray which is available in conventional X-ray tables.

Although a preferred embodiment of the new serialographic device has been described in considerable detail with respect to both construction and function, such de-

scription is intended to be illustrative rather than limiting, for the invention may be variously embodied and is to be limited only by construction of the claims which follow.

We claim:

1. A serialographic device adapted for insertion in the bucky tray of an X-ray table, comprising:

(a) a substantially planar base,

(b) an upper assembly superimposed on and secured to the base,

(c) a cassette access cover on top of the upper assemby,

(d) a tray means for receiving a film cassette in the upper assembly, said cover having an aperture for admitting an X-ray image to a quadrant of a film cassette in the cassette tray means,

(e) first guide means in the upper assembly supporting the cassette tray means for being driven reversibly in generally one line along the first guide means,

(f) second guide means in the upper assembly supporting both the cassette tray means and first guide means for being driven reversibly along the second guide means in a second line which is generally at right angles to the first,

(g) a cassette transfer motor mounted in the space between said cover and said base,

(h) a rotatable element supported on the base and adapted to be driven through angular positions by the motor in response to periodic energization of the motor, the angular positions of the rotatable element corresponding with positioning the respective quadrants of a cassette in coincidence with said aperture,

(i) means coupling the cassette tray to the rotatable element at a point radially away from the rotational axis of the latter whereby to shift the cassette tray and present its quadrants in sequence beneath said aperture, and

(j) a counterweight attached to said rotatable element, said counterweight having its center of mass substantially diametrically opposite of the coupling between said cassette tray means and said rotatable element, whereby the mass of the cassette tray means is counter-balanced and retained in a fixed position when the serialographic device is in other than a horizontal plane.

2. The invention set forth in claim 1 wherein:

(a) said counterweight includes a cam means that is rotatable therewith,

(b) a plurality of switches connected in a circuit with said cassette transfer motor and adapted to de-energize the motor when a quadrant has reached coincidence with said aperture,

(c) the said switches being located in the path of the cam means for being operated sequentially thereby.

3. The invention set forth in claim 2 including:

(a) a potentiometer means and a dynamic braking contact in series therewith connected across the terminals of said motor,

(b) a relay adapted to be energized when said aforementioned switches are closed and to be de-energized when they are open,

(c) the said relay when de-energized closing said dynamic braking contact to stop said motor when said aforementioned switches are opened by the cam means when a film quadrant is positioned properly beneath said aperture.

4. A self-contained serialographic device that is adapted for insertion in the bucky tray of an X-ray table comprising:

(a) a relatively thin box-like enclosure having a cassette access cover and an aperture in the cover for admitting an X-ray image to a quadrant of a cassette that is interior of the enclosure,

(b) a cassette tray means in the enclosure,

(c) means supporting said cassette tray means for bilateral movement, whereby to position the various quadrants of a cassette sequentially beneath said aperture,

(d) an electric motor in the enclosure,

(e) a rotatable element journalled in the encolsure and adapted to be driven in a step-by-step manner by the motor,

(f) said rotatable element serving as a crank means, and means connecting said crank means rotatably to the underside of the tray means for shifting the cassette tray means bilaterally to its sequence of positions,

(g) a counterweight having a cam means and being attached to the rotatable element with the center of mass of the counterweight substantially diametrically opposite the crank connection whereby to counterbalance the cassette tray when it is in other than a horizontal plane,

(h) a plurality of limit switches in the enclosure which are operated by the cam means as the rotatable element and counterweight turn, said switches terminating operation of the motor when a quadrant is positioned,

(i) an electrical connector means extending externally of the enclosure and being connected by way of internal conductors to the motor and switches, said connector being adapted to join a mating connector on the bucky of an X-ray table.

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