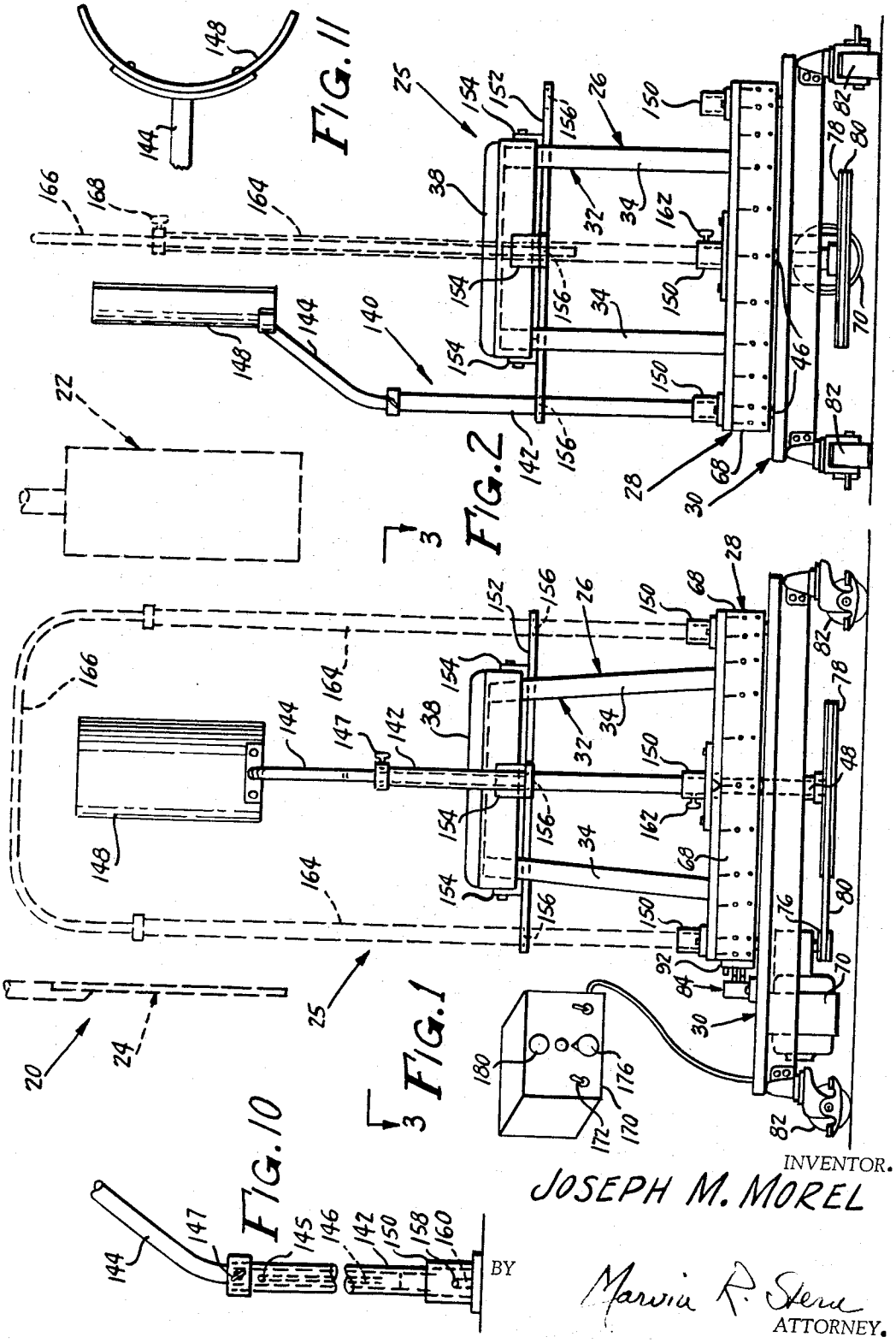
June 27, 1967 J. M. MOREL 3,328,582

ROTATABLE PATIENT SUPPORT WITH MEANS TO SHIFT THE AXIS OF ROTATION IN TWO MUTUALLY PERPENDICULAR DIRECTIONS

Filed Dec. 21, 1964 3 Sheets-Sheet 1



INVENTOR.
JOSEPH M. MOREL

BY Marvin R. Stern
ATTORNEY.

June 27, 1967 J. M. MOREL 3,328,582

ROTATABLE PATIENT SUPPORT WITH MEANS TO SHIFT THE AXIS OF ROTATION IN TWO MUTUALLY PERPENDICULAR DIRECTIONS

Filed Dec. 21, 1964 3 Sheets-Sheet 2

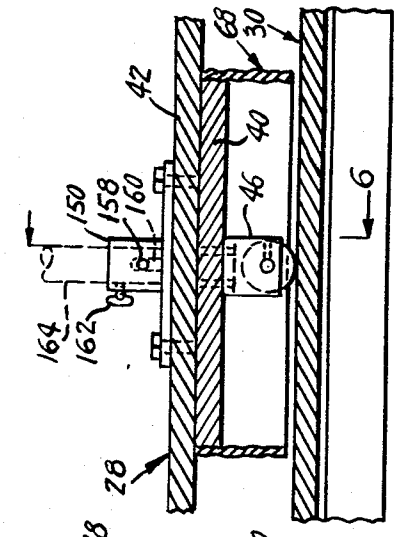


FIG. 5

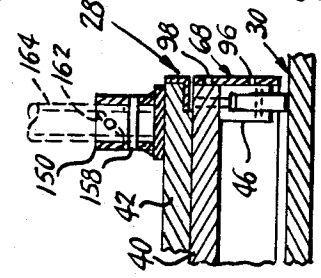


FIG. 6

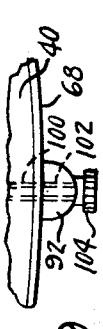


FIG. 9

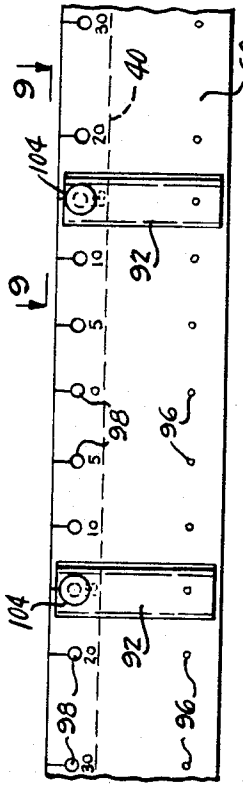


FIG. 8

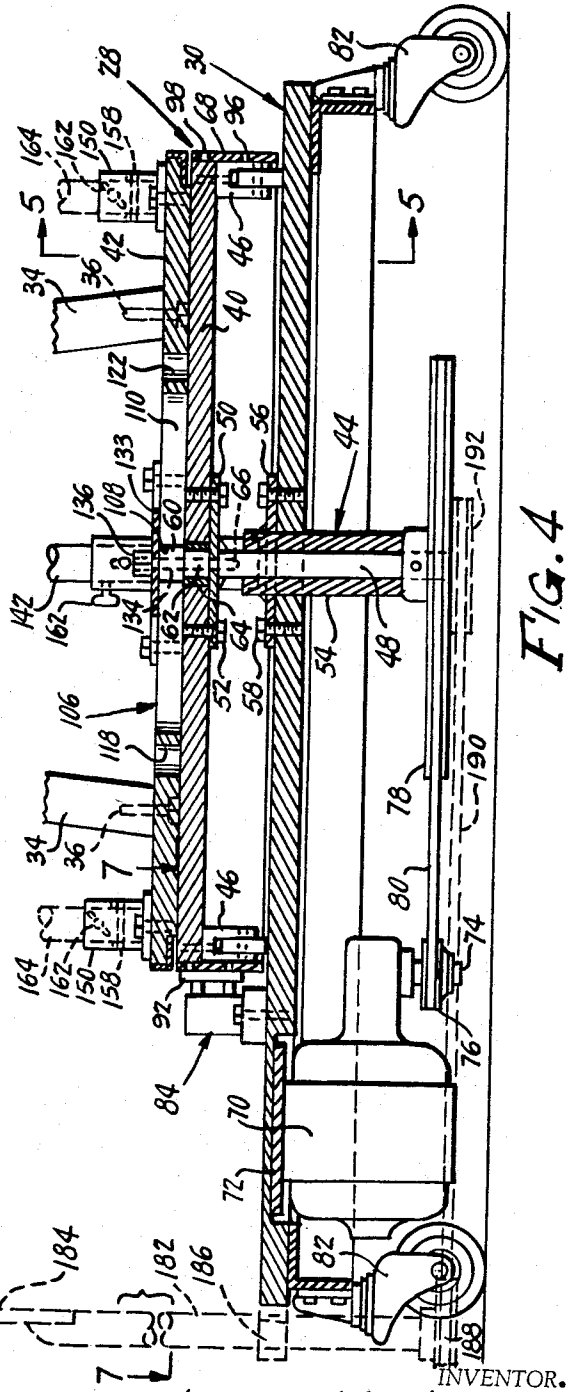


FIG. 4

INVENTOR.
JOSEPH M. MOREL

BY Marvin R. Stern
ATTORNEY.

June 27, 1967 J. M. MOREL 3,328,582

ROTATABLE PATIENT SUPPORT WITH MEANS TO SHIFT THE AXIS OF ROTATION IN TWO MUTUALLY PERPENDICULAR DIRECTIONS

Filed Dec. 21, 1964 3 Sheets-Sheet 3

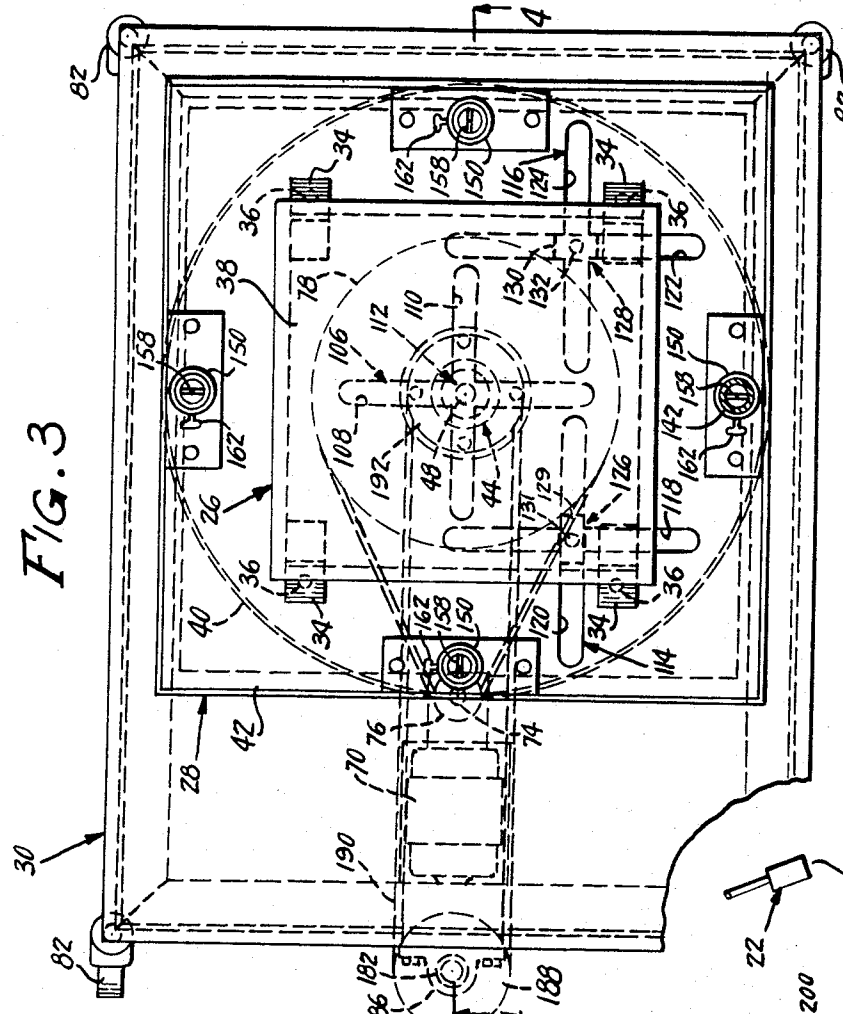


FIG. 3

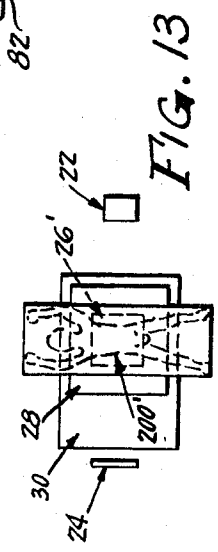


FIG. 13

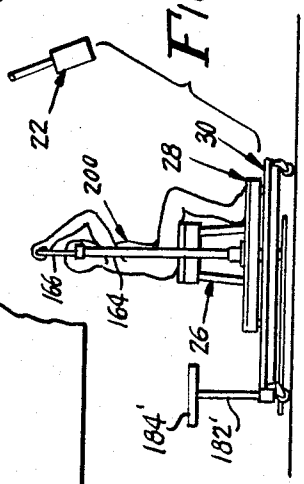


FIG. 12

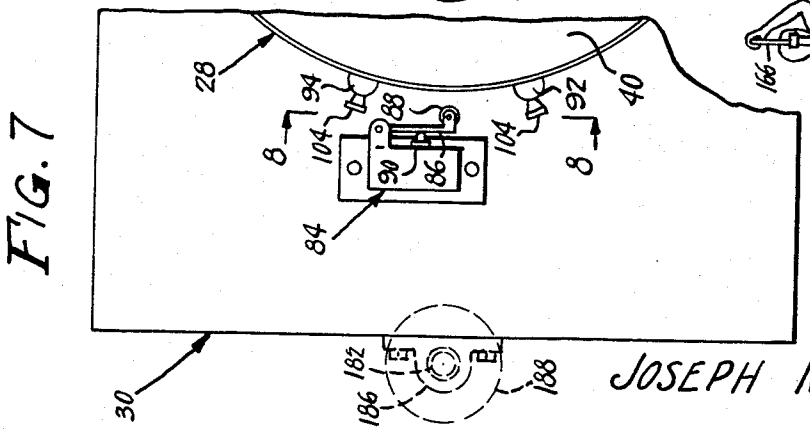


FIG. 7

INVENTOR.
JOSEPH M. MOREL

BY Marvin R. Stern
ATTORNEY.

United States Patent Office 3,328,582
Patented June 27, 1967

3,328,582

ROTATABLE PATIENT SUPPORT WITH MEANS TO SHIFT THE AXIS OF ROTATION IN TWO MUTUALLY PERPENDICULAR DIRECTIONS

Joseph M. Morel, Mount Airy, Md., assignor to the United States of America as represented by the Secretary of the Department of Health, Education, and Welfare

Filed Dec. 21, 1964, Ser. No. 420,226
11 Claims. (Cl. 250—61.5)

ABSTRACT OF THE DISCLOSURE

A radiographic system, particularly a device to be interposed between an X-ray source and a film-carrying cassette. The device includes a base which may be rollably supported, a turntable rotatably carried by the base, a platform laterally adjustable in at least two mutually perpendicular directions with respect to the turntable and a patient supporting means carried by the platform. A switch forming part of the circuit connected to the X-ray source is carried by the base in juxtaposition to the turntable and is successively engaged by switch actuating members adjustably carried by the turntable, the first switch actuating member closing the circuit and energizing the X-ray source and the second switch actuating member breaking the circuit and de-energizing the X-ray source. The preferred means for laterally offsetting the platform and thus the patient supporting means includes at least two parallel cruciform shaped guideways in the platform with guide members carried by the turntable and slideably received in the guideways. In the preferred modification immediate centering of the platform with respect to the axis of rotation can be effected by positioning elongated guides at right angles to each other in the different guideways. Special immobilizing means are shown for preventing movement of the head of the patient and for preventing movement of the body of the patient. The cassette can also be rotated in synchronism with the patent supporting means and either in the same direction or in the reverse direction with respect thereto.

The invention described herein may be manufactured and used by the Government of the United States of America for governmental purposes without the payment to applicant of any royalty thereon.

This invention relates to a radiographic system and relates more particularly to a system in which a film-carrying cassette is spaced from an X-ray means, and a patient having a body portion to be X-rayed is positioned therebetween.

As conducive to a better understanding of the instant inventive concept, this application is directed to an improvement in the X-ray photographic technique known as tomography wherein a single selected plane of an object being X-rayed is photographed with the outline of structures in other planes substantially eliminated. In contradistinction to the rectilinear sections resulting from conventional tomographic techniques, the plane or section according to the basic concept of this invention is situated about an axis of rotation, having a substantial rectilinear central portion with widening terminal portions on either side thereof. Such results are accomplished by providing a rotatable patient-supporting device positionable between the X-ray means and the film-carrying cassette, a selected section of the patient being supported in line with the axis of rotation and being photographed on actuation of the exposure circuit of the X-ray means, sections of the patient laterally spaced from the axis of rotation forming the widening terminal portions of the radiograph.

According to a further feature of the instant inventive concept, if a rectilinear plane or section is desired, the film-carrying cassette means may be rotated in correlation with the patient-supporting device to maintain the entire section of the patient in perfect focus throughout the exposure.

A primary object of this invention is the provision of a patient-supporting device adapted to be positioned in a radiographic system, the device being rotatable about a substantially vertical axis of rotation and including means operatively connected to the X-ray exposure circuit to automatically initiate, and subsequently terminate, exposure at a predetermined point in the rotation.

Another object of this invention is to provide a device of the type described which is versatile, lightweight and portable whereby it may be readily utilized with radiographic systems in any desired location.

A further object of the instant invention is the provision of a device for use in a radiographic system having a patient-supporting means laterally movable with respect to the center of rotation so that any vertical body axis may be centered and immobilized whereby a substantially infinite number of body sections may be taken, adjustment to the center position of the patient-supporting means, that is, the non-offset, most frequently used, position, being quickly and easily effected for normal sections.

A particular important objective of this invention is the provision of a radiographic system wherein the exposure time may be minimized to a point allowing for definitive sections of rapidly moving body parts.

As a corollary of the previous objective, it is desired according to this invention to provide a radiographic system wherein various body structures such as soft tissues and lesions not adequately revealed in conventional normal or sectional films heretofore available would be clearly demonstrated.

A further object of the instant invention is the provision of a rotatable patient-supporting device for use in a radiographic system wherein the point of initiation and termination of the exposure during the rotation may be readily varied and wherein the duration or interval of exposure may also be easily adjusted.

Yet another object of the instant invention is to provide a rotating device of the type described wherein the speed and direction of rotation may be adjusted and varied to minimize unstabilizing effects caused by the initiation of the rotation at a high speed such as whiplash or the like, and to limit the distance through which a patient must be rotated before he is sufficiently stationary for good radiographs to be taken.

According to a further feature of this invention, various immobilizing means are included in the patient-supporting device to facilitate securing portions of the patient's body to be X-rayed against movement, the immobilizing means being quickly and easily adjusted and modified for taking different body sections.

Consistent with all of the above objectives, it is desired to provide a rotatable patient-supporting device for use in a radiographic system which is sturdy and durable in construction, reliable and efficient in operation, and relatively simple and inexpensive to manufacture, assemble, utilize and maintain.

Other and further objects reside in the combination of elements, arrangement of parts and features of construction.

Still other objects will in part be obvious and in part be pointed out as the description of the invention proceeds and as shown in the accompanying drawings wherein:

FIGURE 1 is a front elevational view of a device in accordance with the instant inventive concept, a conventional X-ray means and cassette means being schematically shown in dotted lines, and an additional form of immobilizing means also being shown dotted, a control box for the device being shown in perspective;

FIGURE 2 is a side elevational view of the device of FIGURE 1;

FIGURE 3 is an enlarged transverse cross-sectional view taken substantially on line 3—3 of FIGURE 1, various hidden parts being shown in dotted lines and rotating cassette means in accordance with a modification of the instant inventive concept also being shown dotted;

FIGURE 4 is a still further enlarged fragmentary vertical cross-sectional view taken substantially on line 4—4 of FIGURE 3, the rotating cassette means being shown dotted and partially broken away;

FIGURE 5 is a fragmentary cross-sectional detail view taken substantially on line 5—5 of FIGURE 4 particularly showing the rollable support for the turntable means;

FIGURE 6 is a transverse cross-sectional view taken substantially on line 6—6 of FIGURE 5;

FIGURE 7 is a fragmentary plan view taken substantially on line 7—7 of FIGURE 4, particularly showing the details of the switch and switch actuating means, the rotating cassette means being indicated in dotted lines;

FIGURE 8 is an enlarged pattern of a portion of the side surface of the turntable means with the switch actuating means being carried thereon showing one relationship between these elements in detail;

FIGURE 9 is a fragmentary top plan view taken substantially on line 9—9 of FIGURE 8;

FIGURE 10 is an enlarged fragmentary side elevational view of a portion of the head immobilizing means, hidden parts being shown in dotted lines and portions being broken away for illustrative convenience;

FIGURE 11 is an enlarged top plan view of the upper portion of the head immobilizing means illustrating the same in detail.

FIGURE 12 is a schematic showing of a modified use of the device of the instant invention including a rotating cassette means carrying the film in a substantially horizontal plane for producing transverse body sections of a vertically positioned patient; and

FIGURE 13 is a schematic showing of still another modified use of the device of this invention wherein a stretcher or other similar device is included in the patient supporting means to permit the placement of the patient in a supine, prone or lateral recumbent position.

Like reference characters refer to like parts throughout the several views of the drawings.

Referring now to the drawings in general, and more particularly to FIGURE 1, a radiographic system in accordance with one embodiment of the instant inventive concept is designated generally by the reference numeral **20** and comprises basically an X-ray means schematically shown at **22** in dotted lines, a film-carrying cassette means shown schematically in dotted lines at **24**, and a patient-supporting device **25** positioned therebetween in a manner and for a purpose to be described in more detail hereinafter.

It is to be understood that the X-ray means **22** may take any conventional form and may be either fixedly secured to a supporting surface or portable. Further, the X-ray means **22** may be adjustable either vertically only or vertically and laterally in any well-known manner. Similarly, the cassette means **24** may take any conventional form, also being either fixed to a supporting surface or portable and being readily adjusted vertically and/or laterally in any manner obvious to those with ordinary skill in the art. Correlation of vertical movements, for example, of the X-ray means **22** and the cassette means **24** may be effected for the taking of radiographs of various body portions such as skull, chest, abdomen or the like. It is also to be understood that the type of film carried by the cassette means **24** does not form a part of the instant invention, but rather would be varied as is known to those familiar with radiographic procedures depending upon the results desired.

The X-ray means **22** includes a conventional exposure circuit (not shown) which is usually initiated and terminated by activation of an off-on switch (not shown) by a radiologist to begin and end the exposure of the film. The details of this circuit will vary somewhat with the device being utilized, but can be readily modified in a manner to be pointed out hereinafter for incorporation of the instant inventive concept.

The device **25** includes a patient-supporting means **26**, a rotatable turntable means **28** and a base means **30**. As will be seen particularly with reference to FIGURES 1, 2, and 4, the patient-supporting means **26** is illustratively shown as a wooden stool **32** having a plurality of supporting legs **34** secured by screws or the like **36** to the turntable means **28** for rotation therewith, and a seat **38** spanning the legs **34** for carrying the patient (not shown).

It is to be understood that although a wooden type stool is shown in the drawings, other conventional supporting means could be readily substituted therefor as will be obvious to those with ordinary skill in the art. Note, for example, FIGURE 13.

The turntable means **28** includes a turntable member **40** which slidingly carries a platform member **42**, this assembly being rotatably supported on the base means **30** by a central bearing structure **44** and rollably carried on the base means **30** by a plurality of peripherally spaced roller bearings **46**.

Referring particularly to FIGURE 4, it will be seen that the central bearing structure **44** includes a turntable drive shaft **48** having an outstanding flange **50** secured by screws **52** or the like to the underside of the turntable member **40** and extending downwardly therefrom through a bearing sleeve **54** having a similar outstanding flange **56** fixed by screws **58** or the like to the base means **30**. A centrally bored brass plug **60** has a lower end portion **62** received in a cup-shaped upper extension **64** of the turntable drive shaft **48**, an internally threaded or tapped counterbore **66** being defined in the turntable drive shaft **48** for a purpose to be described in more detail hereinafter.

The roller bearings **46** are secured to the underside of the turntable member **40** within a peripheral side surface defined by a depending annular flange **68** formed of aluminum strip or the like, the roller bearings **46** maintaining the lower edge of the flange **68** in spaced relationship to the upper surface of the base means **30**. Note FIGURES 4–6.

A drive means is secured to the base means **30** and is operatively connected to the turntable means **28** for rotating the same about a substantially vertical axis of rotation. As illustrated in the drawings, the drive means includes a motor **70** carried by an angular motor mount **72** secured in a milled pocket in the underside of the base means **30**, the motor **70** having a drive shaft **74** carrying a pulley means **76** operatively connected to a substantially larger pulley means **78** by a flexible means in the form of a belt **80** or the like, the enlarged pulley means **78** being secured to the turntable drive shaft **48** for rotating the turntable means **28** at a somewhat reduced speed.

The base means **30** is preferably supported by a plurality of wheel means in the form of caster members **82** selectively locked in any conventional manner whereby the device **25** is rendered portable. In other words, it may be readily moved on the caster members **82** until it is positioned in a desired relationship with respect to the remaining components of a radiographic system with which it is to be utilized and the wheels may then be locked to fix the device against further movement.

As an important feature of the instant inventive concept, a switch means **84** is fixably secured to the base means **30** in juxtaposition to the side surface **68** of the turntable member **40**, the switch means **84**, as illustrated

particularly in FIGURE 7, including a pivoted lever arm 86 carrying a roller 88 at its terminal end and engaging a spring-pressed button 90 intermediate its ends, the switch means being operatively interposed or integrated into the exposure circuit of the X-ray means 22 in any conventional manner. A switch actuating means comprising a pair of switch actuating members 92, 94, is secured to the side surface 68 of the turntable member 40 and operatively engages the switch means 84 on rotation of the turntable means 28 for first initiating, and subsequently terminating, the X-ray exposure. It is to be understood that the particular construction of the switch means 84 is not significant to the instant inventive concept nor is its circuitry arrangement with respect to the exposure circuit of the X-ray means 22. Various circuitry designs will be obvious to those with ordinary skill in the art for operatively interposing the switch means 84 in the exposure circuit of the X-ray means 22. It is only necessary to cause initiation of the exposure on pressing of the button 90 by engagement of the roller 88 with the protuberant portions of the first switch actuating member encountered, for example, switch actuating member 92, and to subsequently cause termination of the exposure on again pressing of the button 90 by engagement of the roller 88 with the protuberant portions of the other switch actuating member encountered, for example, switch actuating member 94.

As shown particularly in FIGURES 8 and 9, the side surface 68 of the turntable member 40 may have a plurality of lower apertures 96 defined therein in peripherally spaced relationship at selected intervals with a threaded bore 98 vertically aligned with each of the apertures 96. Each switch actuating member may be provided with a lower pin member 100 for engagement in a selected one of the apertures 96 and an upper rotatable securing member 102 having a knurled head 104 to facilitate threadably engaging the same with the bore 98 aligned with the selected aperture 96. In this manner the switch actuating members 92, 94 may be readily removed and repositioned on the side surface 68 of the turntable member 40 whereby the initation and termination of X-ray exposure may be carried out at any point during the rotation of the turntable means 28 and whereby the interval of X-ray exposure may be varied by changing the spacing between the switch actuating mmebers 92, 94, the positions of the apertures 96 and bores 98 being preferably indicated on the side surface 68 by reference to their spacing from a designated zero point. For example, as shown in FIGURE 8, X-ray exposure will take place during a 30° arc, or 15° on either side of zero, although, as pointed out hereinafter, substantially shorter intervals of exposure on the order of approximately 10° are preferred for many radiographic procedures utilizing the device of this invention.

In order to avoid having to move the entire device 25 for taking different sections of a patient supported thereby, the platform member 42 carrying the patient-supporting means 26 may be laterally offset with respect to the axis of rotation about the turntable drive shaft 48. To accomplish such an offset, it is only necessary to provide in the platform member 42 at least two spaced guideways each being of cruciform shape and each having at least two perpendicular arms crossing to define center apertures, the arms of one guideway being parallel to the arms of the other guideway, with guide members carried by the turntable member 40 being slidably received in the guideways. However, the most advantageous relationship is illustrated in the drawings, particularly referring to FIGURES 3 and 4, wherein portions of the platform member 42 define a first cruciform-shaped guideway 106 having perpendicular arms 108 and 110 crossing to define a center aperture 112 aligned with the axis of rotation when the patient-supporting means 26 is centered. Further portions of the platform member 42 define a pair of additional cruciform-shaped guideways 114, 116, each having perpendicular arms 118, 120 and 122, 124, respectively, parallel to the arms 108, 110 of the first guideway 106 and crossing to define substantially square center apertures 126, 128 spaced from each other and from the center aperture 112 of the first guideway 106. Guide members in the form of substantially rectangular blocks 129, 130 carry downwardly extending pins 131, 132 removably received in apertures (not shown) defined in the turntable member 40, the blocks 129, 130 being slidably received in the guideways 114, 116. Each of the blocks 129, 130 has a long dimension larger than the center apertures 126, 128 of the additional guideways 114, 116, whereby the blocks 129, 130 may be rotated 90° to align the long dimensions with selected arms of the additional guideways 114, 116 in order that the platform member 42 may be laterally offset forward, backward or to either side from its center position. If it is desired to utilize the center position, which would be the most frequently used arrangement, the long dimension of one block may be positioned perpendicularly to the long dimension of the other block as shown particularly in FIGURE 3 whereby the patient-supporting means 26 will be quickly and accurately centered with respect to the axis of rotation, the blocks 129, 130 precluding accidental offsetting of the same.

A lockdown means is provided including a washer 133 and an elongated bolt 134. The bolt 134 extends through the washer 133 and the first guideway 106 into threadable engagement with the tapped counterbore 66 in the turntable drive shaft 48 and has a socket head 136 engageable by an actuating member such as a wrench or the like (not shown) to readily lock the platform member 42 to the turntable member 40 in any adjusted relationship.

Various immobilizing means may be associated with the device of the instant invention to secure selective portions of the patient in fixed relationship to the axis of rotation of the turntable means 28. Two such immobilizing means are shown as illustrative in the drawings and have been found to be particularly advantageous for use with the device 25. The first such means is shown in full lines in FIGURES 1 and 2, further details being illustrated in FIGURES 10 and 11. This means comprises a head immobilizing device 140 including a substantially vertically extending standard member 142 telescopingly carrying an offset element 144 with a pin 145 slidingly received in a keyway 146 to preclude relative rotation between the members, a screw means 147 being provided to secure the same in vertically adjusted relationship. The offset element 144 carries an arcuate plastic head supporting element 148 against which the forehead of the patient may be engaged to substantially immobilize the skull of the patient during rotation of the turntable means 28. Any additional immobilizing means such as belts or the like securing the head of the patient to the head support element 148 may be utilized in conjunction with this device.

A plurality of bracket members 150 are carried by the platform member 42 preferably spaced at 90° intervals. An additional supporting element 152 has perpendicular arms which are secured by angular elements 154 to the patient-supporting means 26 beneath the seat 34. The terminal portions of the arms of the supporting element 152 include apertures 156 defined in alignment with the bracket members 150. Referring particularly to FIGURES 4, 5 and 6, a roll pin 158 is diametrically secured in each bracket member 150 and is received in a slot 160 defined in the lower portion of the standard member 142. A screw means 162 is utilized to lock the standard member 142 in position, the pin 158 preventing rotation within the bracket members 150. Thus, it can be seen that the head immobilizing means 140 may be readily positioned in any of the bracket members 150 through the aligned aperture 156 in the supporting element 152 depending upon the placement of the patient on the supporting means 26.

Additionally, an immobilizing means in the form of an inverted U-shaped member, shown in dotted lines in the drawings, includes a pair of leg elements **164**, the lower ends of which have slots **160** defined therein similar to the slot in the standard member **142**, the legs **164** being received in opposite bracket members **150**, extending through aligned apertures in the supporting element **152**. A connecting element **166** is telescopingly received in the leg elements **164** extending in overlying relationship to the patient-supporting means **26**. Note particularly FIGURE 1. Screws means **168** may be provided to secure the connecting element **166** in vertically adjusted relationship. With this alternate device the patient may reach overhead to grasp the connecting element **166** thereby substantially immobilizing various body portions such as his chest or abdomen during rotation of the turntable means **28**. Once again, additional immobilizing means may be utilized in conjunction with this structure to further secure the patient's body against movement during the rotation procedure. Further, the U-shaped member may be repositioned 90° to afford radiographs of the body in the anterior-posterior or lateral views.

Control of the motor **70** may be accomplished remotely from a control box shown schematically at **170**. This control box may include a conventional toggle switch **172** operatively connected to the motor **70** to change the direction of rotation from clockwise to counterclockwise and another conventional toggle switch **174** to turn the power "on" and "off." Additionally, a conventional variable speed control **176** may be included whereby the rotation may be initiated at a relatively low speed and slowly raised to the desired rate to preclude instability of the patient caused by whiplash or the like during sudden starting at the ultimate speed. A telltale light **178** to indicate that the device is operating and a conventional manual control means **180** in the event manual rotation is desirable under certain circumstances, may be included in the control circuit.

As mentioned hereinbefore, in certain instances, it is desirable to provide a substantially rectilinear section as opposed to one having widening end portions. It is within the concept of the instant invention to include means to provide such a result. One form such a means may take is shown in dotted lines in FIGURES 3, 4, and 7, wherein cassette supporting means including a vertical supporting element **182** carrying a conventional cassette means **184** at its upper end are rotatably supported in one or more bearings **186** or the like carried by the base means **30**. Additional bearing supports may be provided, as desired. The lower end of the supporting element **182** carries a pulley **188** operatively interconnected with one of the drive shafts, a flexible belt **190** being shown as extending between the pulley **188** and an additional pulley **192** carried by the turntable drive shaft **48** for rotating the cassette means **184** in a 1 to 1 ratio with respect to the patient supporting means **26**. The cassette means **184** is rotated about an axis parallel to, and spaced from, the axis of rotation of the turntable means **28**, and at a speed and in a direction substantially corresponding to the speed and direction of the turntable means **28**. It will be readily understood that if it is desired to rotate the cassette means **184** in a direction opposite to the direction of rotation of the turntable means **28** for various radiographic techniques, the belt **190** may be crossed in a conventional manner.

Referring particularly to FIGURE 12, it will be seen that transverse body-section radiographs of a vertically positioned patient **200** may be effected by angling the X-ray means **22** approximately 30° from a horizontal plane and directed to a chosen point in the patient **200** above the axis of rotation of the turntable means **28**. The resultant plane is projected onto a film maintained in horizontal relationship by a modified rotating cassette means **184'** perpendicularly carried by a supporting element **182'**. Such a system will produce a transverse as contrasted with a coronal or sagittal, section.

According to a further feature of the invention, the patient supporting means may be modified as shown at **26'** in FIGURE 13 by providing a stretcher or other horizontally extending surface removably or fixedly secured to the stool of the previous embodiments. In this manner, the patient **200'** may be placed in a supine or prone position in order to produce sagittal sections of the skull, spine, chest, etc. Coronal sections of these same and other body parts can be obtained by placing the patient **200'** in a right or left lateral recumbent position.

The use and operation of the device of the instant invention will now be apparent. If a fixedly supported X-ray means **22** and cassette means **24** are to be utilized, the device **25** is rolled into position therebetween on the caster wheels **82** which are subsequently locked to preclude further movement. A patient is then seated on the supporting means **26** facing in any desired direction depending upon the portions of his body to be radiographed. If a skull X-ray is to be taken the head immobilizing means **140** is secured in a desired bracket member **150** through one of the apertures **156** in the supporting element **152** with the offset element **144** being vertically adjusted as necessary. The patient's forehead is then engaged against the arcuate plastic head supporting element **148** and immobilized in any conventional manner. Since this element is made of plastic, it may be located intermediate the X-ray means **22** and the cassette means **24** without substantially distorting the resultant radiograph.

Alternately, the leg elements **164** of the U-shaped immobilizing means may be engaged in a selected pair of bracket members **150** through aligned apertures **156** for engagement of the connecting element **166** by the patient to immobilize selected body portions such as his chest or abdomen for subsequent radiographic procedures.

The X-ray means **22** and the cassette means **24** may be vertically adjusted to align the same with the particular portions of the patient's body to be studied.

The switch actuating members, **92**, **94** are then secured in any desired location around the periphery of the side surface **68** of the turntable member **40** depending upon the relative position of the patient on the supporting means **26** and the desired interval of exposure. Of course, the arc transversed between the switch actuating members **92**, **94** will have to be correlated with the speed of rotation of the turntable means **28**, a procedure which would be well within the skill of the ordinary artisan. It will be readily understood that if a plurality of sections are desired, additional pairs of switch actuating members may be secured around the periphery of the side surface **68** of the turntable member **40**. In this manner, for example, radiographic sections spaced by 90 degrees may be taken during a single rotation of the turntable means **28**, a conventional cassette changer being utilized to avoid double exposure.

If a section aligned with the axis of rotation of the turntable means **28** is desired, the guide blocks **129**, **130** may be positioned at right angles to each other as shown in FIGURE 3, thereby quickly and accurately centering the platform member **42** on the turntable member **40**. However, if the section to be taken is to be laterally offset forwardly, rearwardly or to either side of the axis of rotation of the turntable means **28**, the long dimensions of the guide block **129**, **130** may be aligned with selected arms of the additional guideways **114**, **116** and the platform member **42** slid in the desired direction. The lock-down means may then be secured by the washer **133** being tightly secured against the platform member **42** by rotation of the socket member **136** to threadably engage the bolt member **134** in the tapped bore **66** of the turntable drive shaft **48** whereby the laterally offset relationship between the platform member **42** and the turntable member **40** will be maintained during subsequent rotation.

It will be readily seen that although only two perpendicular arms have been shown in each of the guideways in the platform member **42**, a plurality of additional arms parallel to, and spaced from, each of the perpendicular arms of the guideways may be provided for increasing the versatility of the device by permitting substantially infinite variation in the ability to select a particular body section to be radiographed without necessitating moving of the patient on the support means **26**.

After the patient has been secured in desired position, and the switch actuating members selectively located, the toggle switch **172** is actuated to determine the direcion of rotation of the turntable means **28** and the toggle switch **174** is actuated to provide power to the motor **70**. The variable speed means **176** may be preset, if desired, to automatically rotate the turntable means **28** at a particular angular velocity on movement of the toggle switch **174** to the "on" position, or it may be manually actuated to slowly increase the speed from a standstill to the ultimate desired velocity. In any event, the speed with which the spacing of the switch actuating members **92, 94** has been correlated should be attained by the time the first switch actuating member engages the switch means **84** to actuate the same and initiate exposure by the X-ray means **22**. As the turntable means **28** continues its rotation, the second switch actuating member will engage the switch means **84** to terminate the X-ray exposure and rotation of the turntable means **28** may likewise be terminated by the "on-off" toggle switch **174** or the variable speed means **176**.

As an example of a typical use of the device of the instant invention, the ultimate speed of the turntable means may reach one revolution every six seconds with the switch actuating members **92, 94** being set five degrees on either side of a zero location thereby providing a total exposure arc of 10° and an exposure time of ⅙ second. Thus, it can be seen that extremely short exposure intervals can be utilized thereby necessitating minimum X-ray exposure of the patient and facilitating particularly accurate radiographs of certain normally difficult body portions such as various soft tissues and lesions otherwise difficult to reveal. Remarkably good demonstrations have resulted of auditory ossicles and kidneys, verification being provided by the device of this invention of other diagnostic evidence of tumors which could not otherwise be shown radiographically. Similarly, the relatively short exposure interval facilitates clear and accurate X-ray photographs of moving body parts such as calcified heart valves appearing as a mere blur in more conventional radiographic systems.

Variotion of the X-ray interval, the speed of rotation of the turntable means **28**, the intensity of the X-ray means **22**, the distances between the X-ray means **22**, the patient and the film-carrying cassette means **24** or **184**, for particular radiographic techniques may be readily accomplished by those with ordinary skill in the art.

It will now be seen that there is herein provided an improved radiographic system which satisfies all of the objectives of the instant invention and others, including many advantages of great practical utility and commercial importance.

Since many embodiments may be made of the instant inventive concept, and since many modifications may be made of the embodiments hereinbefore shown and described, it is to be understood that all matter herein is to be interpreted merely as illustrative and not in a limiting sence. Accordingly, what is claimed is:

1. In a radiographic system including X-ray source means, circuit means for energizing the X-ray source means, and a cassette means supporting film in spaced relationship to the X-ray source means, the improvement which comprises a device positioned between the X-ray source means and the cassette means, said device including a base means, a turntable means rotatably supported by said base means, drive means for rotating said turntable means relative to said base means about a substantially vertical axis of rotation, switch means secured to said base means in juxtaposition to said turntable means, said switch means forming part of the circuit means of the X-ray source means and being actuatable to first complete the circuit means to energize the X-ray source means and then break the circuit means to de-energize the X-ray source means, a first switch actuating member carried by said turntable means and engageable with said switch means on rotation of said turntable means to complete the circuit means and a second switch actuating member carried by said turntable means and engageable with said switch means on further rotation of said turntable means to break the circuit means, a patient supporting means including a platform carried by said turntable means for rotation therewith, adjustable means interconnecting said platform and said turntable means for laterally offsetting said platform with respect to said axis of rotation in at least two mutually perpendicular directions, said adjustable means including portions of said platform member defining at least two spaced guideways each having at least two perpendicular arms crossing to define center apertures, the arms of one guideway being parallel to the arms of the other guideway, guide members carried by said turntable means and slidably received in said guideways, and lockdown means for securing said platform to said turntable means in adjusted relationship.

2. A radiographic system in accordance with the claim **1** further including a plurality of selectively locked caster members rollably supporting said base means whereby said device is portable.

3. A radiographic system in accordance with the claim **1** wherein said drive means includes means for varying the speed and means for varying the direction of rotation of said turntable means.

4. A radiographic system in accordance with claim **1** wherein said drive means includes a motor means having a motor drive shaft, a turntable drive shaft secured to said turntable means at said axis of rotation, and flexible means interconnecting said drive shafts.

5. A radiographic system in accordance with claim **4** further including cassette supporting means carrying the cassette means and rotatably supported by said base means, and an additional flexible means interconnecting one of said drive shafts and said cassette supporting means for rotating said cassette supporting means about an axis parallel to, and spaced from, said axis of rotation of said turntable means and at a speed substantially corresponding to the speed of rotation of said turntable means.

6. A radiographic system in accordance with claim **1** further including an immobilizing means comprising an inverted U-shaped member having a pair of leg elements secured to opposing portions of said turntable means and a connecting element extending between said leg elements in overlying relationship to said patient supporting means whereby the patient may reach overhead to grasp said connecting element thereby substantially immobilizing the body portion of the patient during rotation of said turntable means.

7. A radiographic system in accordance with claim **6** further including bracket members carried by said platform member at 90 degree intervals, said leg elements being removably securable in a selected pair of opposed bracket members.

8. A radiographic system in accordance with claim **1** further including an immobilizing means comprising a substantially vertically extending standard member secured to said platform member, and a head support member carried by said standard member, said head support member including an arcuate plastic element against which the forehead of the patient may be engaged thereby substantially immobilizing the head portion of the patient during rotation of said turntable means.

9. A radiographic system in accordance with claim **1** wherein said platform member includes portions defining

a first guideway having at least two perpendicular arms crossing to define a center aperture aligned with said axis of rotation when said patient supporting means is centered, further portions of said platform member defining a pair of additional guideways having at least two perpendicular arms parallel to said arms of said first guideway and crossing to define substantially square center apertures spaced from each other and from said center aperture of said first guideway, guide members slidably received in said additional guideways, each guide member including a substantially rectangular block having a long dimension larger than said center apertures of said additional guideways, said blocks being removably carried by said turntable means whereby they may be rotated 90 degrees to align said long dimensions with selected arms of said additional guideways, said long dimension of one block being positioned perpendicularly to said long dimension of the other block to center said patient supprting means with respect to said axis of rotation, said lockdown means including a member extending through said first guideway to secure said platform member to said turntable means in adjusted relationship.

10. A radiographic system in accordance with claim **1** wherein said turntable means is substantially circular and includes portions defining a peripheral side surface, said switch actuating members being secured to said side surface, and said switch means being secured to said base means in juxtaposition to said side surface.

11. A radiographic system in accordance with claim **10** wherein portions of said turntable means define a plurality of apertures spaced about said side surface at desired intervals, further portions of said turntable means defining a threaded bore vertically aligned on said side surface with each of said apertures, each of said switch actuating members including a protuberant portion for engaging said switch means during rotation of said turntable means, a pin member for engagement in a selected one of said apertures, and a securing member threadably engageable with the bore aligned with the selected aperture.

References Cited

UNITED STATES PATENTS

2,145,686	1/1939	Dessaner	250—50
2,196,618	4/1940	Watson	250—61.5
3,789,231	4/1957	Dumer	250—61.5

RALPH G. NILSON, *Primary Examiner.*

W. F. LINDQUIST, *Assistant Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,328,582 June 27, 1967

Joseph M. Morel

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 12, line 21, "3,789,231" should read -- 2,789,231

Signed and sealed this 5th day of August 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents