

Aug. 18, 1942.

T. VLADEFF

2,293,324

RADIOGRAPHY PROCESS AND APPARATUS

Filed April 16, 1940

3 Sheets-Sheet 1

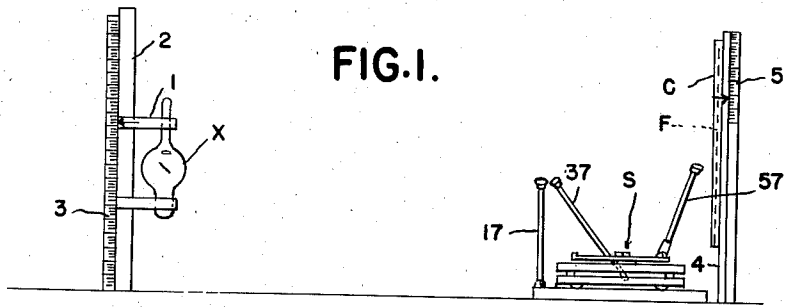


FIG. 4.

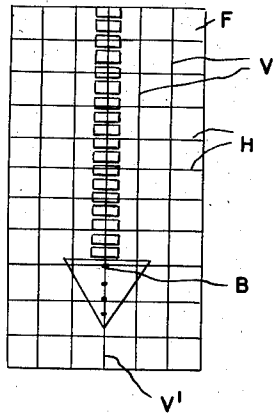


FIG. 5.

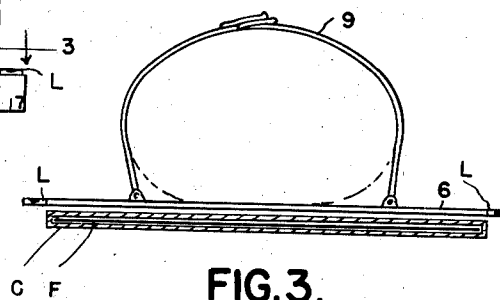
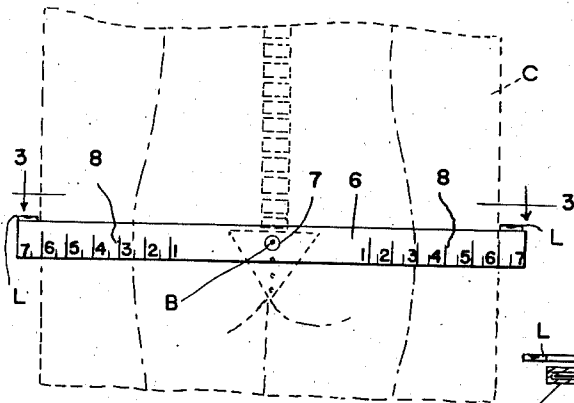
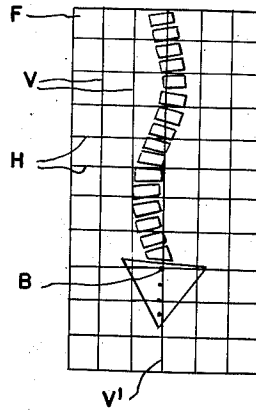


FIG. 2.

FIG. 3.

INVENTOR.

THEODORE VLADEFF

BY

Swan, J. E. Hendley
ATTORNEYS

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FIG. 6.

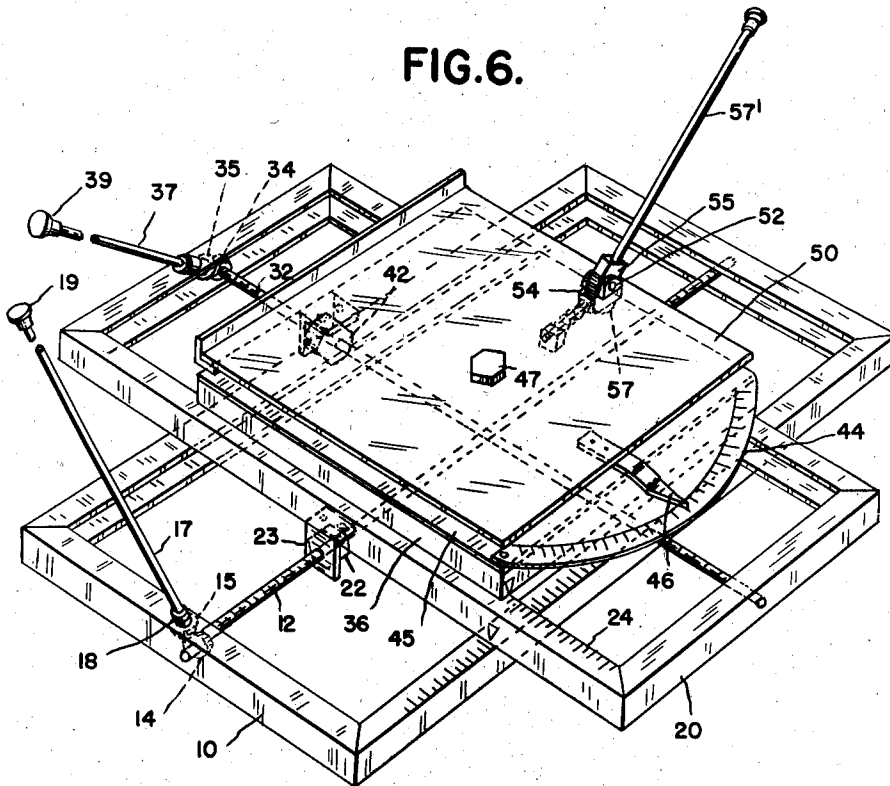


FIG. 10.

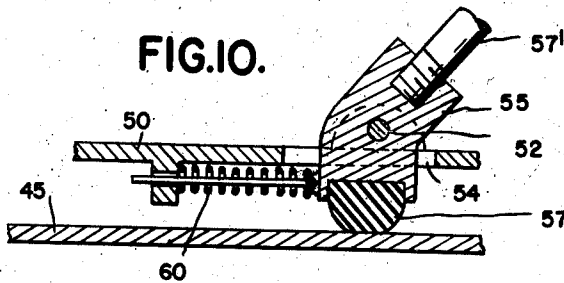
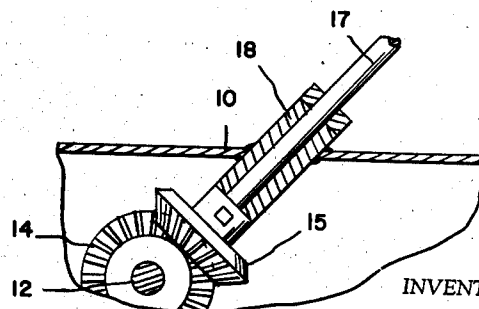


FIG. 9.



INVENTOR.

BY
THEODORE VLADEFF
Swan, Joyce Handley
ATTORNEYS

Aug. 18, 1942.

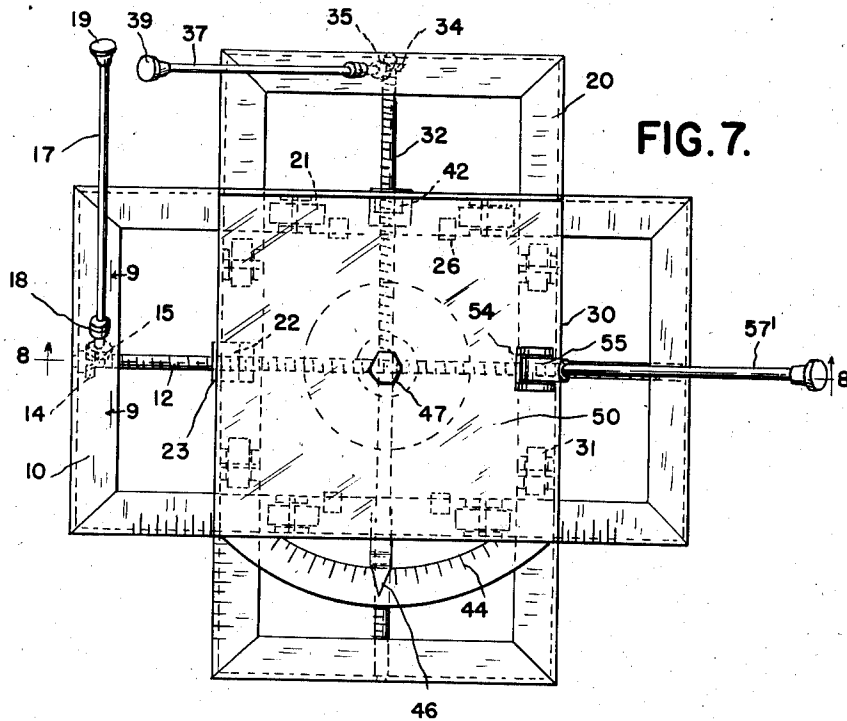
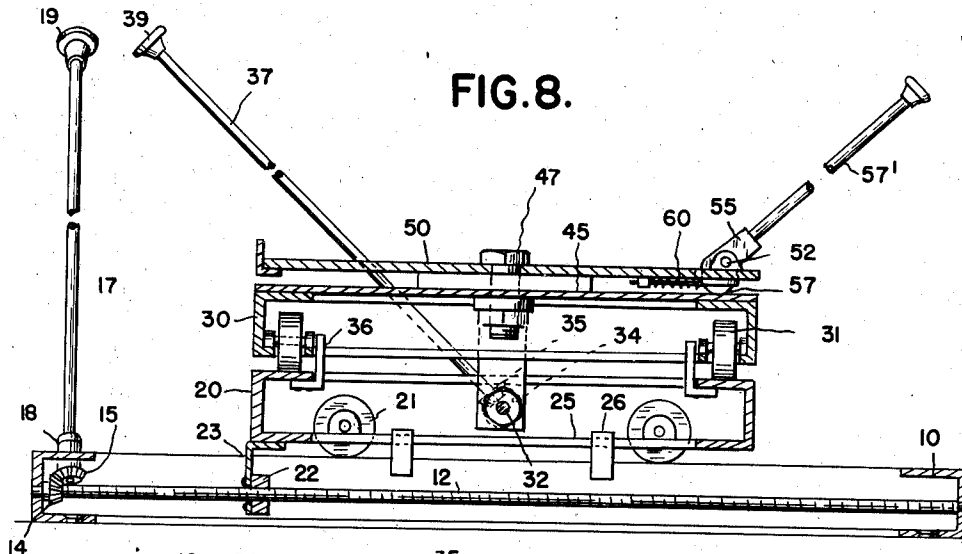
T. VLADEFF

2,293,324

RADIOGRAPHY PROCESS AND APPARATUS

Filed April 16, 1940

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INVENTOR.

THEODORE VLADEFF

BY

Samuel J. Hardy
ATTORNEYS

UNITED STATES PATENT OFFICE

2,293,324

RADIOGRAPHY PROCESS AND APPARATUS

Theodore Vladoff, Detroit, Mich.

Application April 16, 1940, Serial No. 329,937

7 Claims. (Cl. 250—59)

This invention relates to X-ray processes and apparatus, and particularly to improved means for taking X-ray photographs, and for recording the conditions under which such photographs are taken.

In studies of the human spine, for the purpose of determining maladjustments, it has long been the practice to take full length spinal radiographs. These photographs are preferably taken with the patient in a standing posture, in order that the various parts of the body and spine may occupy their normal positions with relation to each other, under their normal loads and forces. The various parts of the spine are rarely if ever perfectly regular, and particularly in people needing corrective treatment the parts are apt to be rotated out of their normal positioning. Since X-ray pictures are really "shadow pictures" or silhouettes, the apparent proportions of the parts, as shown in the picture, depend upon their angular relationship with respect to the source of the rays, foreshortening and/or prolongation being created by any oblique relationship between the parts to be photographed and the line of propagation. It has in the past, for this reason, been a practical impossibility to take X-ray photographs in a way which would show accurately the relative size and positioning of the parts, although it has been customary to reduce distortion as much as possible by twisting the body of the patient in such manner as to present the parts whose accurate representation is desired as nearly perpendicular to the rays as possible. This method entails the serious disadvantage of making it impossible to view the parts in their normal relaxed relationship, and accordingly defeats, to a degree, the entire purpose of the photograph. When the photographs are taken by this method, also, it is impossible to provide any reference system permitting accurate reproduction at a subsequent date of the original photographic conditions, and accurate comparative studies of the progress of a patient by means of successive photographs are impossible, for the reason that the distorting effects resulting from differences in the position of the patient introduce variables which are too great in proportion to changes due to progress.

The present invention has as its principal object the provision of an improved method of taking X-ray photographs, in such manner as to overcome the aforementioned and other difficulties inherent in presently known processes, and to provide means whereby distortion due to wrong positioning of the parts to be photo-

graphed may be eliminated, without, however, disturbing the natural posture of the patient, and whereby the relative positioning of the parts with respect to both the X-ray source and the photographic plate may be positively fixed, and accurately registered, in a manner enabling exact duplication of conditions at any desired subsequent time, so that the resulting photographs not only show the parts without distortion, but in a predetermined and known relative positioning. This process accordingly permits, for the first time, accurate comparative measurements of the showings of successive X-ray photographs, and positive determination, thereby, of the progress of a patient under treatment.

Another object of this invention is to provide an improved system for the taking of X-ray photographs which not only eliminates unwanted distortion, in the manner stated, but which provides means for accurately registering the parts of the body of the patient with lines of reference carried by the film, so that accurate measurements of deviations of the parts with respect to such lines of reference may be made.

A related object is the provision of an improved process for determining aberrations of the spine, including means for utilizing the upper tubercle of the sacrum as a basis for measurement of the extent of aberration, and for accurately registering such tubercle with lines of reference previously provided upon a photographic film, and, further, for preventing distortion of the showing of the parts without disturbing the relaxed position of the patient while a photograph is taken with the tubercle in the aforementioned registry.

Still another object is to provide relatively simple and inexpensive, sturdy, reliable and accurate apparatus for carrying out the aforementioned process, whereby the patient may be supported and moved to achieve the aforementioned registry, and whereby such registry may be determined and recorded.

Other objects and advantages will be apparent from the following description, wherein reference is made to the accompanying drawings illustrating a preferred embodiment of my invention and wherein similar reference numerals designate similar parts throughout the several views.

In the drawings:

Figure 1 is a diagrammatic side elevational view of radiographic apparatus, including adjustable means for supporting the patient and for making and recording the adjustments re-

quired to achieve the aforementioned registry and to eliminate distortion.

Figure 2 is a rear elevational view of gauging device employed to insure desired registry of the parts to be photographed with respect to the film, diagrammatically indicating in dotted lines the relative position of the film holder and the body of the patient.

Figure 3 is a top view of the gauging device, corresponding to a horizontal section taken substantially on the line 3—3 of Figure 2 and looking in the direction of the arrows.

Figure 4 is a diagrammatic representation of a radiograph made in accordance with the present process, indicating the registry of a normal and regular spine with the indicia provided upon the film.

Figure 5 is a view similar to Figure 4 indicating the method of alignment of a rotated spine with the indicia of the film, and showing the character of the finished radiograph.

Figure 6 is a perspective view of an adjustable supporting device for adjusting the positioning of the patient to secure the aforementioned registry with the film, eliminate distortion, and at the same time provide recordable indication of the final adjustment, parts of the operating handles being broken away.

Figure 7 is a plan view of the device.

Figure 8 is a vertical section taken substantially on the line 8—8 of Figure 7 and looking in the direction of the arrows.

Figure 9 is a sectional detail taken substantially on the line 9—9 of Figure 7 and looking in the direction of the arrows; and

Figure 10 is an enlarged sectional detail of the brake mechanism for the rotatable top platform.

Referring now to the drawings:

X indicates a source of Roentgen rays, or other rays capable of penetrating opaque material and affecting a photographic plate. The source is shown as a commercial X-ray tube. The tube is mounted by means of brackets 1 to slide vertically of a standard 2 which is provided with indicia 3 permitting the adjusted height of the tube to be recorded. The sensitized film F is mounted in a suitable carrier C, supported in appropriate position upon a standard 4 and vertically slidable therealong for adjustment, indicia 5 being provided to permit recording of the adjusted height of the film. The distance between the source of rays and the film is preferably fixed, or at least is predetermined and uniform for all photographs made for comparative purposes of the same subject.

An adjustable support, generally designated S, is arranged in front of the film carrier in such manner that the subject, when standing upon the support, may be moved in all directions, and turned, with respect to the film and the path of the rays, to permit registration of the subject with the film as well as to eliminate distortion. The process involved, and manner in which these effects are secured, will presently be described.

The film F is provided with coordinate lines, V, H, extending vertically and horizontally thereof, respectively. These are of course uniform upon all films, and accurately placed, to permit accurate comparisons of successive films. One of the lines V' is equidistant from the edges of the film.

The standard S, the construction of which will presently be described, permits movement of the

subject both laterally of and toward and from the film carrier, as well as rotation of the patient about a vertical axis.

Since both the film and the spine of the patient are concealed while the photograph is being taken, the patient's back being flat against and close to the film carrier, and it is desired to register the spine in a predetermined manner with respect to the film line V', special alignment indicating means is required. The upper tubercle of the sacrum is used as the basic point of reference, and with this point aligned with line V', and the patient in an upright position, deviation of the spine from that line may be accurately measured. A thin gauge stick 6 is provided with a central aperture 7 which is adapted to be registered over the upper tubercle, and from the center of such opening, indicia 8, extend toward opposite ends of the stick, points equidistant from the center being designated by like numerals. By means of a belt 9 the gauge stick is adapted to be attached to the back of the patient in centered and horizontal position, as shown in Figure 2. The film is so mounted in the carrier, and the carrier is so positioned in the standard 4, that centerline V' is located centrally of the standard when the film is in place. The stick is of sufficient length to permit its ends to be viewed from behind the standard 4 when the patient is located properly in front of it. Thus by lateral adjustment of the patient, indicia 8 may be registered with the edges of the standard in such manner that like numerals appear at both edges, and such registry will align the tubercle B with the line V'. Spirit levels L may be carried by the gauge stick at the ends which remain visible, to assist in proper alignment by enabling maintaining the stick level.

The X-ray tube and film carrier C are adjusted vertically in such manner as to direct the rays squarely at the point B, thereby eliminating even the slight distortion which might be caused by the divergence of the rays, and the patient is turned to compensate for rotation of the spine, and to dispose those parts whose accurate silhouette is desired as nearly perpendicular to the path of the emanation as possible. Complete details of the adjusted positioning of the subject may be recorded, by virtue of the nature of the adjustable support, which will presently be described, and it is thus possible to recenter the point B of the patient upon a film, to take a subsequent picture under like conditions, at any later date. From the two pictures, differences in the deviation of the spine may accurately be determined. Figure 4 shows the ideal alignment of a straight spine with the line V', while Figure 5 shows the alignment of the tubercle of a rotated spine, illustrating the accurate comparison between the various parts of the spine and the reference line V', which is possible with radiographs made in accordance with the present process.

The adjustable support will be seen to comprise a hollow rectangular frame 10, which may be formed of channel iron, and centrally of which is disposed a screw shaft 12, journaled in the end sections of the frame. Fast upon one end of the shaft within the frame is a miter gear 14, with which meshes a second miter gear 15, fast upon the lower extremity of the handle shaft 17, which projects angularly through the frame and extends thereabove to a convenient height for manipulation by the operator. The shaft is supported by a bearing sleeve 18, welded or otherwise secured in the upper web of the channeled

frame section 10. The frame is adapted to be screwed or otherwise attached to the floor.

The traveling frame 20, of similar hollow rectangular construction, is arranged transversely of and adapted to travel along the fixed frame 10 upon wheels or casters 21 journaled therein and which roll upon the top web of the lower frame. A traveler nut 22 is attached to frame 20 by means of an anchor bracket 23, and it will readily be apparent that frame 20 may be moved at will by rotating screw shaft 12 through the agency of knob 19. The wheels 21 are journaled in cross braces 25 which extend across the frame 20 in position to overlie the side rails of the fixed frame 10, and alignment of these frames is maintained by guide brackets 26 secured to braces 25 and extending downwardly within and in sliding relation with respect to the side rails of the fixed frame. The guide brackets also preferably underhang the fixed frame to prevent separation of the frames.

A second traveling frame, 30, is rollable along the traveling frame 20, to provide for adjustment in a transverse path, the width of frame 30 being such that its wheels 31 may roll along the top of the side channels of frame 20. Brackets 36 extend downwardly inside the frame 20 to maintain alignment of the frames 30, 20. Movement of the carriage 30 is effected by means of a knob 39 attached to a shaft 37 similarly mounted in an end section of traveling frame 20 and adapted to drive, through miter gears 34, 35, a screw shaft 32, journaled in frame 20 and coacting with a traveling nut 42 secured to carriage 30 to actuate the same. A plate 45 is welded or otherwise secured across the top of frame 30 and supports a centrally disposed stud 47 which rotatably carries the top platform 50.

Platform 50 is normally held against rotation by a releasable brake mechanism, consisting of a pivoted shoe 55, journaled in platform 50 upon a transverse pin 52, and having a lower extremity which projects through an aperture 54 and carries a rubber or other suitable friction facing 57 engageable and disengageable with the plate 45 when the shoe is swung by means of the handle 57. The friction facing is normally urged against plate 45 by means of a compression spring 60, which maintains the handle raised, and it will be seen that this holds the platform against turning, while in order to rotate the same it is only necessary to press downwardly upon the handle, to lift the friction facing free of plate 45, whereafter the platform may be turned at will, and is locked in position as soon as the handle is released to allow the same to rise. Handle 57 projects angularly outwardly to enable the same to be conveniently used to swing the platform and so turn the patient, who stands on the platform during the X-ray treatment or photography.

A scale is provided along the upper surface of each of the frame assemblies 10, 20, as indicated at 14, 24, and suitable cooperating indicia upon the traveling frames, 20, 30 serve to indicate the position which these frames occupy at all times. An arcuate scale 44 also projects from plate 45, and the cooperating pointer 45 attached to platform 50 provides continuous indication of the angular position of the latter.

It is thus only necessary to have the patient stand upon the upper platform 50 and assume a relaxed posture, whereafter he may be turned and adjusted as to position to eliminate shadowing and provide the best view of the parts of the body which it is desired to show, as well as to center

the upper tubercle of the sacrum in the manner previously described. For a patient unable to stand, a stool may of course be placed on platform 50. The data as to the necessary adjustments are noted for future reference and comparison, although even without such data the patient may be recentered and rephotographed with the upper tubercle in proper alignment and proper comparisons made.

I am aware that the invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire the present embodiment to be considered in all respects as illustrative and not restrictive; reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

I claim:

1. The process of taking radiographs of the human spine which comprises providing a source of penetrative photographable radiation and a sensitized film having a line of reference disposed in known spacial relationship thereupon, mounting said film in a support in known relation thereto, aligning the upper tubercle of the sacrum of the subject with said support in such manner as to align said tubercle with said line of reference on the film, and projecting through the body of the subject in the area of the sacrum and spine a penetrative photographable radiation.

2. The process of taking radiographs of the human spine which comprises providing a source of penetrative photographable radiation and a sensitized film with a line of reference disposed in known spacial relationship thereupon, mounting said film in a support in known relation thereto, and with said line substantially vertical, standing the subject in front of said support and aligning the upper tubercle of the sacrum of the subject with said support in such manner as to align said tubercle with said line of reference, and projecting said radiation through the body of the subject in the area of the sacrum and spine.

3. The process of taking radiographs of the human spine which comprises providing a penetrative photographable radiation and a sensitized film with a line of reference disposed in known spacial relationship thereupon, mounting said film in a carrier in known relation thereto, and with said line substantially vertical, standing the subject upon a movable support in front of said carrier, moving the support to shift the subject bodily with relation to said carrier in such manner as to align the upper tubercle of the sacrum of the subject with said carrier and thereby with said line of reference, and projecting such radiation through the body of the subject in the area of the sacrum and spine and substantially perpendicularly to the plane of the film.

4. The process set forth in claim 3 in which said support is also rotatable about a vertical axis, and including the further step of rotating said support, before the projection of said radiation, to dispose the parts to be photographed in desired angular relationship to the line of propagation of the radiation and the plane of the film, to enable controlling or substantially eliminating distortion due to the projection of the image onto a flat plane.

5. The process set forth in claim 3 in which the source of radiation is vertically movable, including the further step of moving said source vertically, before the projection of said radiation.

tion, to bring the line of propagation of the radiation as nearly as possible perpendicular to the film at the point at which said tubercle overlies the film.

6. The process set forth in claim 3 in which said support is also rotatable about a vertical axis, and the source of radiation is vertically movable, including the further steps of moving said source vertically, and of rotating said support, before the projection of said radiation, to bring the line of propagation as nearly as possible perpendicular to the film at the point at which said tubercle overlies the film, and to dis-

pose the plane of the parts to be photographed as nearly perpendicularly as possible to the line of propagation.

7. The process set forth in claim 3 including the further step of attaching to the body of the subject a gauging device adapted to extend beside the carrier, preliminarily aligning said gauging device with said tubercle, and thereafter and before the projection of said radiation aligning said gauging device with said carrier to register said tubercle with said line of reference.

THEODORE VLADEFF.