A. F. ZULAUF.

PANORAMIC X-RAY APPARATUS.

APPLICATION FILED JAN. 7, 1920.

1,408,559.

Patented Mar. 7, 1922.

3 SHEETS—SHEET 1.

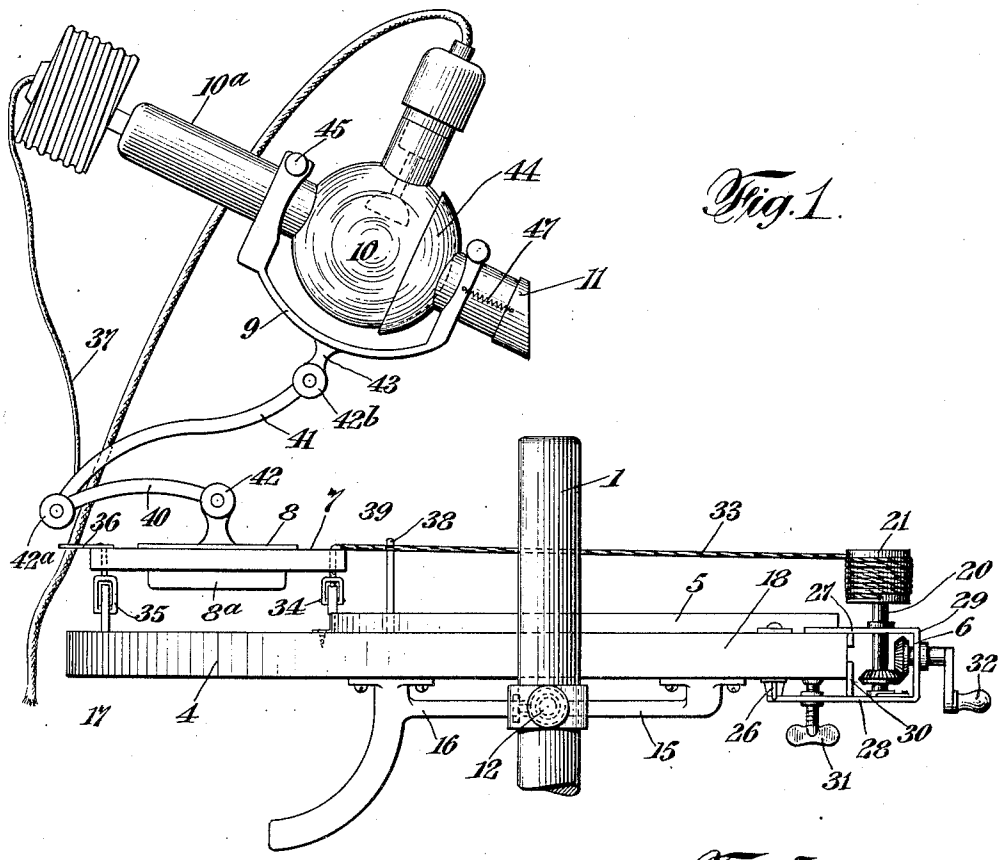


Fig. 1.

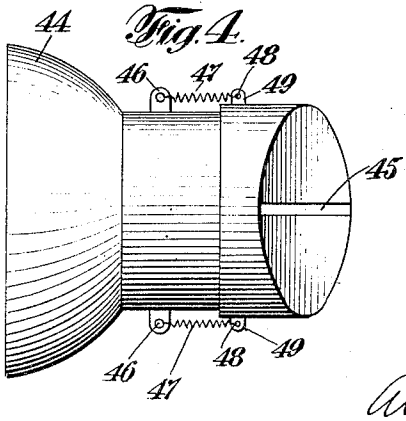


Fig. 4.

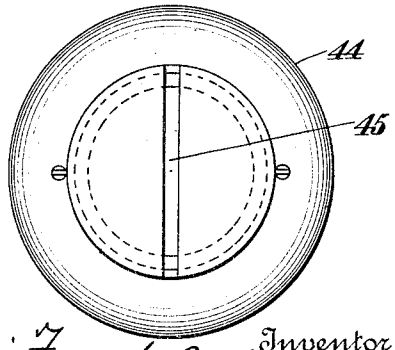


Fig. 5.

Inventor

Alvin Frank Zulauf

By his Attorneys

Williamson & Pritchard

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3 SHEETS—SHEET 2.

Fig. 2.

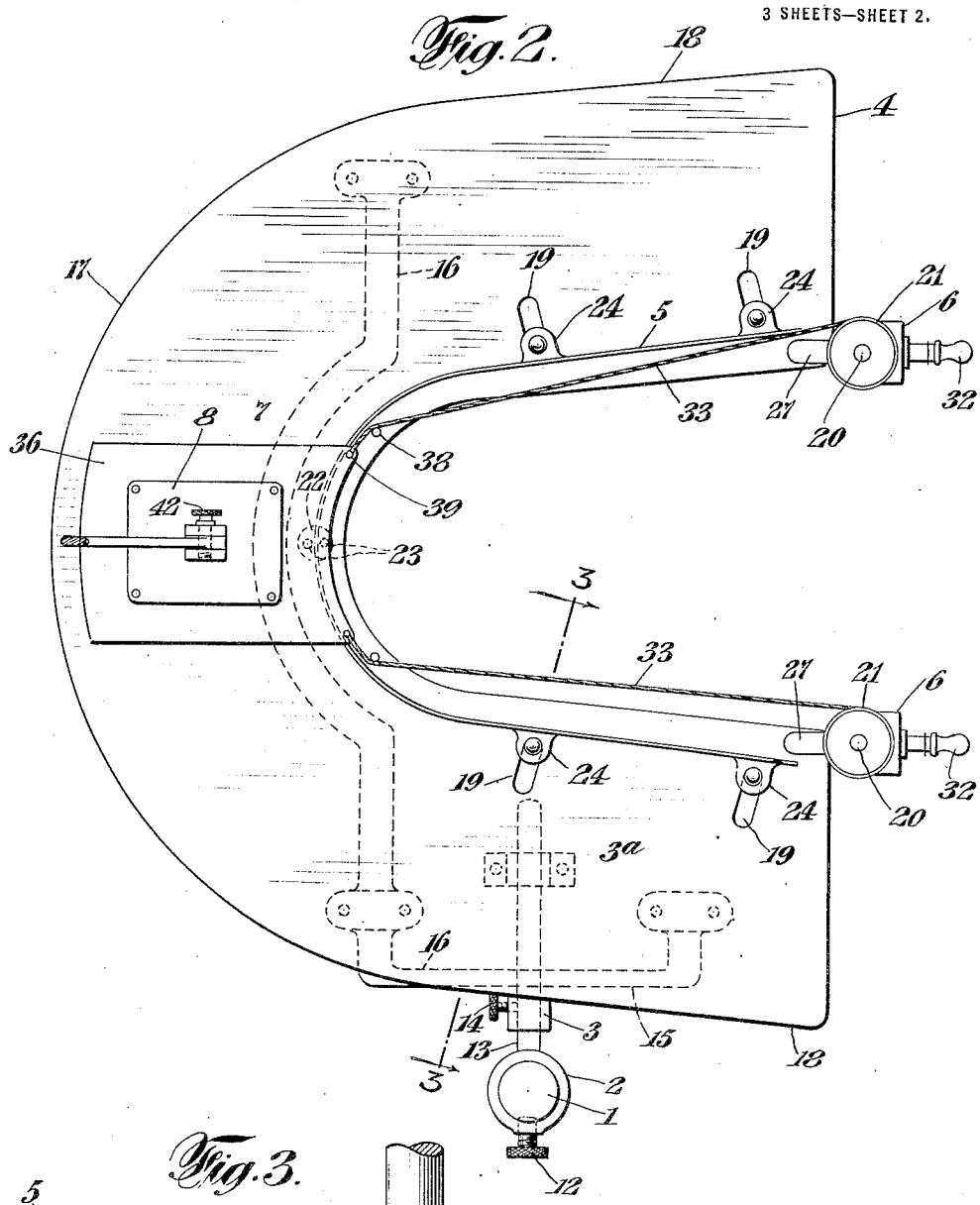
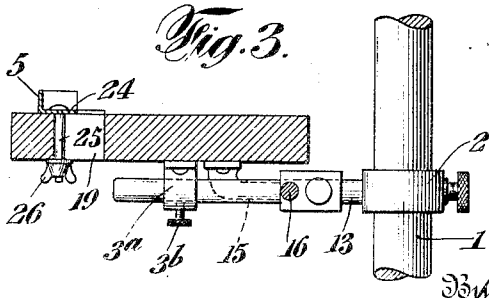


Fig. 3.



Inventor

Alvin Frank Zulauf

By his Attorneys

Williams & Cutchard

A. F. ZULAUF.

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3 SHEETS—SHEET 3.

Fig. 6.

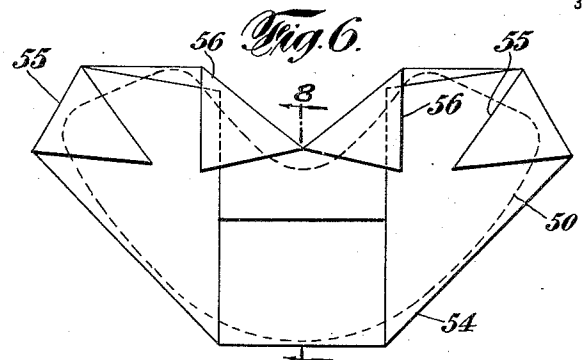


Fig. 7.



Fig. 8

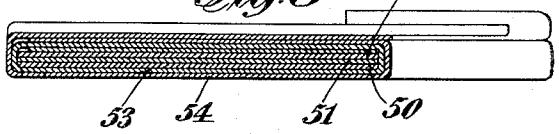


Fig. 9.

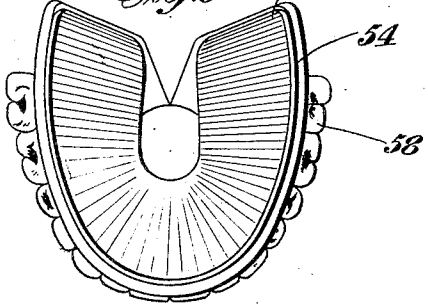
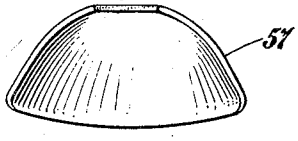


Fig. 10.



Inventor

Albert Frank Zulauf

By his Attorneys

Williamson & Cutchard.

UNITED STATES PATENT OFFICE.

ALVIN FRANK ZULAUF, OF BROOKLYN, NEW YORK.

PANORAMIC X-RAY APPARATUS.

1,408,559. Specification of Letters Patent. Patented Mar. 7, 1922.

Application filed January 7, 1920. Serial No. 349,929.

To all whom it may concern:

Be it known that I, ALVIN FRANK ZULAUF, a citizen of the United States, residing in the borough of Brooklyn, city of New York, county of Kings, State of New York, have invented certain new and useful Improvements in Panoramic X-Ray Apparatus, of which the following is a specification.

This invention relates to a dental X-ray machine for obtaining panoramic X-ray shadow-photographs. One object of this invention is to provide a machine which will indicate the exact condition of each and every tooth and associated structures of either the upper or lower jaw or both upon a single negative with one exposure. Hitherto, whenever it was desired to obtain an X-ray shadow-photograph or "shadowgraph" of the entire dental arches, and contained teeth, it was necessary to make a series of separate exposures using a different film for each exposure. As will be evident, such a procedure was not only time-consuming but also expensive of material and labor.

Another object of this invention is to provide a U-shaped photographic film suitably protected with light-proof and water-proof material, to be inserted in the patient's mouth behind the teeth while they are being photographed. An X-ray generator which may be of any conventional type, is mounted upon a carriage and is adapted to be moved around the patient's mouth upon a curved table shaped in accordance with the contour of the patient's face and teeth. In order to prevent double-exposure and the fogging which would otherwise result, a control-sleeve is placed over the end of the X-ray generator. The control-sleeve has a narrow vertical slit shielding all but a small central portion of the rays from the X-ray generator and it allows clearly defined negatives to be secured.

Another object of this invention is to produce an X-ray machine adapted not only for obtaining panoramic shadowgraphs of a complete set of teeth and associated parts, but which may also be used for taking a shadowgraph of a single tooth, associated parts, or groups of teeth. In the latter case the curved table serves as a very convenient means of rapidly moving the X-ray generator from one position to another.

Another object is to produce a backing of lead or other X-ray impervious material to be placed adjacent and behind the photographic film in the mouth in order to prevent double exposure and fogging whenever the negative is to be used for securing a shadowgraph of the teeth tissue etc. upon both sides of the jaw. This backing will not be required however, when a shadowgraph of a single tooth or object is being made.

Other objects of this invention will appear in the accompanying specification and claims forming a part thereof. One embodiment of the invention is illustrated in the accompanying drawings wherein:

Figure 1 is a side view in elevation of the improved X-ray apparatus.

Figure 2 is a top view of the apparatus with the X-ray generator removed.

Figure 3 is a sectional view upon the line 3—3 of Figure 2 showing the method of clamping the track to the table.

Figures 4 and 5 are top and front views respectively of the X-ray control-tube.

Figures 6 and 7 are views in plan and elevation showing the construction of the photographic film and its waterproof packet.

Figure 8 is a sectional view taken on line 8—8 of Figure 6.

Figure 9 is a top view of a set of teeth showing the X-ray film packet and its lead backing in position.

Figure 10 is an end view of the X-ray backing.

Referring to Figures 1–5 of the drawings, the X-ray generator 10 is shown mounted upon the movable carriage 7. The carriage 7 rides upon the U-shaped table 4, the latter being vertically adjustable upon the standard 1, by means of the slip collar 2 which slides upon the standard 1 and which may be held securely in any desired position thereon by the set-screw 12. In order to provide for tilting the table to any desired angle, the slip collar 2 is provided with a supporting arm 13. This arm 13 passes through a collar 3 and rests in the cleat 3^a, which carries a set-screw 3^b and is firmly attached to the bottom of the table 4. The collar 3 has arms or brackets 15 and 16 also firmly attached to the bottom of the table 4. The set-screw 14 serves to hold the supporting brackets 15 and 16 in any desired position. The U-shaped table 4 may be constructed of any suitable material, such as

wood, and comprises the curved end portion 17 and the side wings 18, the width of the table preferably being the same throughout its entire length.

For guiding the generator carriage 7 upon the table 4, a track 5, constructed from a narrow flexible strip of metal, wood or other material is attached to the table adjacent to the inner edge thereof, and the track is provided with the flanges 22 and 24. The track is immovably attached to the table at the flange 22 by means of the wood screws 23, but it is adjustably clamped thereto by means of the nuts 26 threaded upon the bolts 25 which extend through the flanges 24 and slots 19.

In practice, it has been found advantageous to have the X-ray generator pass as close as possible to the face of the patient when making a panoramic shadowgraph, and the above construction permits this to be done for any set of teeth whatever its shape. As will be evident it is merely necessary to loosen the thumb nuts 26 to adjust the contour of the track similarly to the contour of the face. After the thumb nuts 26 have been tightened the generator will be in focus no matter what position upon the track it may occupy, thus making it possible to secure any number of photographs of either or both jaws with but one setting of the track.

In order to move the carriage 7 readily upon the table 4, the movable reels 6 are provided with adjustable clamps at the ends of both wings 18 of the table. Each clamp consists of an upper plate 27 and a lower plate 28 and vertical flanges 29 and 30. To fasten the reel 6 securely upon the table, the thumb-screw 31, threaded in the lower plate 28, is provided. Journaled in the plates 27 and 28 is the vertical shaft 20 carrying the drum 21. Wound about both of the drums 21 are the cords 33, which pass around the upright posts 38 and are then attached to the movable carriage at the points 39.

When it is desired to move the carriage upon its track to obtain a photograph, it is merely necessary to rotate one of the handles 32 which are connected to the shafts 20 by suitable gearing whereby the cord 33 will be wound upon the drum 21 adjacent the handle being operated and simultaneously unwound from the drum at the other end of the track. In order to permit the carriage 7 to ride easily, it is provided with two inner wheels 34 and two outer wheels 35. All of these wheels are mounted upon the under surface of the carriage by means of swivel joints as shown. The inner wheels 34 are of smaller diameter than the outer wheels 35, and are countersunk slightly to enable them to securely engage the track 5. Upon the rear of the top of the carriage 7 are the guiding jaws 36 for loosely holding the electrical conductors 37 leading to the X-ray generator.

In order to balance the weight of the X-ray generator 10, which is mounted upon the support 8 on the carriage 7 slightly in the rear of its center, a weight 8^a preferably of lead or other heavy metal may be attached to the bottom of the carriage.

The X-ray generator is carried by the pivoted arms 40 and 41 which may be arranged in various adjusted positions by manipulating the set-screws 42, 42^a and 42^b whereby the generator may be moved into the proper position. The central arm 43 pivoted to the lever 41 supports the U-shaped bracket 9 which holds the X-ray generating apparatus 10. This bracket supports the X-ray tube 10^a, which carries a protecting lead shield 44, and an X-ray "control sleeve" 11, the latter being located at the forward part of the shield 44.

In order to prevent double-exposure when making a continuous panoramic shadowgraph, the beveled end of the "control sleeve" 11 is provided with a vertical slit or aperture 45. (See Figures 4 and 5.) By means of this slit all of the rays from the generator, except a narrow vertical central portion are prevented from striking the teeth being shadowgraphed. The slit 45 of the control sleeve produces a narrow beam of X-rays. This is an important feature of this invention, for it reduces overlapping shadows to the minimum and enables clear cut shadowgraphs to be produced. For the purpose of holding the X-ray control sleeve 11 upon the shield 44, the sleeve is provided with the eyes 49, which are adapted to be engaged by the hooks 48, carried upon one end of the springs 47, the other end of the springs being securely attached to the shield 44 at the eyes 46.

The construction of the U-shaped film packet and the lead backing therefor is illustrated in Figures 6–10 inclusive. The U-shaped packet comprises two sensitized photographic films 50 and 51 arranged with their sensitive sides faced upward in the packet. Above the films 50 and 51 is located a U-shaped "indicating" sheet of black paper 52 adapted to prevent finger marks and the like, when the packet is opened for developing the negatives. To protect the films from the action of light, the films together with the indicating sheet 52, are surrounded by the U-shaped black paper envelope 53. In order to render the film packet immune to the action of saliva when held in the mouth while the film is being exposed, an outer covering 54 of waterproof material is folded about the envelope 53. As shown in Figure 6 the outer waterproof cover is provided with the flaps 55 and 56.

The shape of the X-ray proof lead back-

ing 57 is disclosed in Figures 9 and 10. Figure 9 is a view of the lead backing 57, in operating position located inside the waterproof packet 54 and the set of teeth 58. As will be clear, while one side of the mouth is being photographed, the lead backing behind the U-shaped film entirely absorbs all X-rays which strike it and the lead backing thus prevents fogging of the film on the opposite side of the mouth. The lead backing 57 may of course be used repeatedly but should preferably be sterilized after each use. It is obvious that the backing may be made of any material which will completely absorb the active or primary rays emitted by the X-ray generator and which will at the same time be capable of withstanding the action of saliva and heat of sterilization.

In operation, the proper adjustments to the reels 6, the track 5, the arms 40 and 41, and the bracket 43, are first made. The table is then adjusted to any height desired upon the standard 1. The X-ray generator is then brought to one of the ends of the track 5 and focused upon the back teeth of the jaw or jaws being shadowgraphed. The X-ray control-sleeve must then be placed in position in order to secure a vertical flux of parallel rays. The film packet is then placed in the mouth in the proper position behind the teeth. The current having been turned on, the carriage 7 is then moved around the U-shaped table 4 upon the track 5, by turning the proper handle 32. The speed of the carriage should be uniform in order to secure even exposure of the films. The exact speed of operation can only be determined by experience and depends upon the strength of the X-rays, the width of the slit 45, and its distance from the teeth being shadowgraphed. The motion of the carriage is continued until it reaches the end of the opposite wing of the table from which it starts, and has continuously exposed all of the teeth to the direct primary rays emitted by the target of the X-ray tube.

After the desired exposure has been made the film packet is removed from the mouth of the patient and taken to a dark room where the packet is opened and the negatives developed. The films are preferably used in duplicate in order that one of them may be presented to the patient.

The preferred embodiment of my invention which has been described is but one illustration of the many ways in which it may be carried out.

I claim:

1. An apparatus for producing panoramic X-ray images of an opaque object comprising a generator for casting substantially parallel X-rays upon the object, and means for moving and guiding said generator along a path adjacent to the object.

2. In a machine for producing X-ray photographs of an opaque object, a movable X-ray generator, means for moving said generator along a path adjacent to the object to be photographed, and a sleeve fitting the delivery tube of the generator, said sleeve having a closure with a narrow slit therein, and adapted to shield all but a small central portion of the rays from the X-ray generator target.

3. A machine for producing panoramic X-ray images, comprising an X-ray generator and means for moving said generator in a curved path.

4. In a machine for producing panoramic X-ray photographs, a movable carriage carrying means for emitting X-rays, a track for guiding said carriage, said track being mounted upon a platform adjacent to the object to be photographed, and means for moving the carriage in a curved path while the object is being photographed.

5. In a machine for producing panoramic X-ray photographs, a U-shaped table, a flexible track located upon said table, a carriage movable upon said track carrying an X-ray generator, said track being adjustable upon the table.

6. In a machine for producing dental panoramic X-ray shadowgraphs, a U-shaped table having a track, a carriage movable upon the table and guided by the track, an X-ray generator located on said carriage, and means to move the carriage continuously about the entire jaw of a patient.

7. In a machine for producing dental panoramic X-ray shadowgraphs, a U-shaped table having a track, a carriage movable upon the table and guided by the track, an X-ray generator located on said carriage, a cord attached to said carriage, and wound upon a drum at the end of one leg of the U-shaped table, and means to rotate the drum to wind up the cord.

8. An apparatus for producing a panoramic X-ray dental shadowgraph of the entire mouth of a patient comprising a U-shaped table adapted to surround the front part of the face and head of the patient, a movable carriage resting upon said table, and an X-ray generator mounted upon the carriage for movement around the entire face of the patient.

9. In a machine for producing dental panoramic X-ray shadowgraphs, a table having a track, a carriage movable upon the table and guided by the track, an X-ray generator located on said carriage, means to move the carriage continuously about the entire jaw of the patient, and means for adjusting said table with respect to the jaw of the person.

In testimony whereof I have affixed my signature to this specification.

ALVIN FRANK ZULAUF.