Feb. 14, 1950 D. E. BERGGREN 2,497,755

X-RAY TUBE WITH MOVABLE DIRECTING CONE

Filed May 10, 1946 2 Sheets-Sheet 1

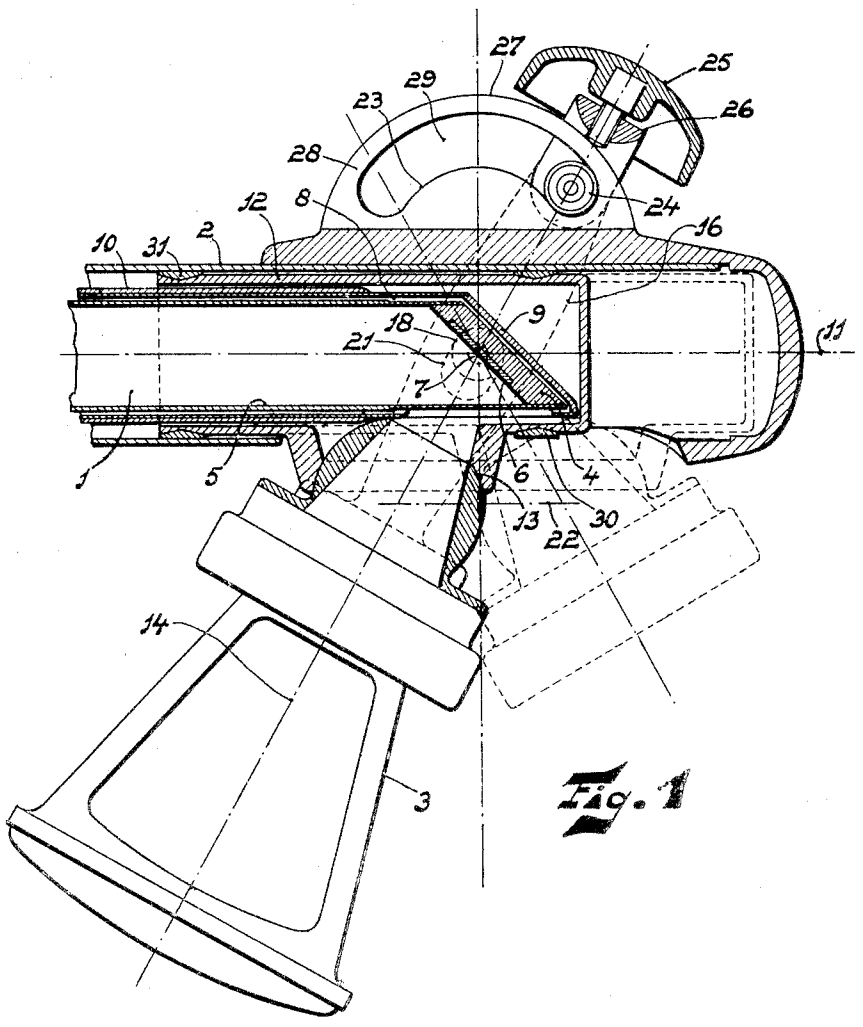

Fig. 1

INVENTOR
DETLOF EMANUEL BERGGREN

BY Alec B. Lemmon.

ATTORNEY.

Feb. 14, 1950 D. E. BERGGREN 2,497,755

X-RAY TUBE WITH MOVABLE DIRECTING CONE

Filed May 10, 1946 2 Sheets-Sheet 2

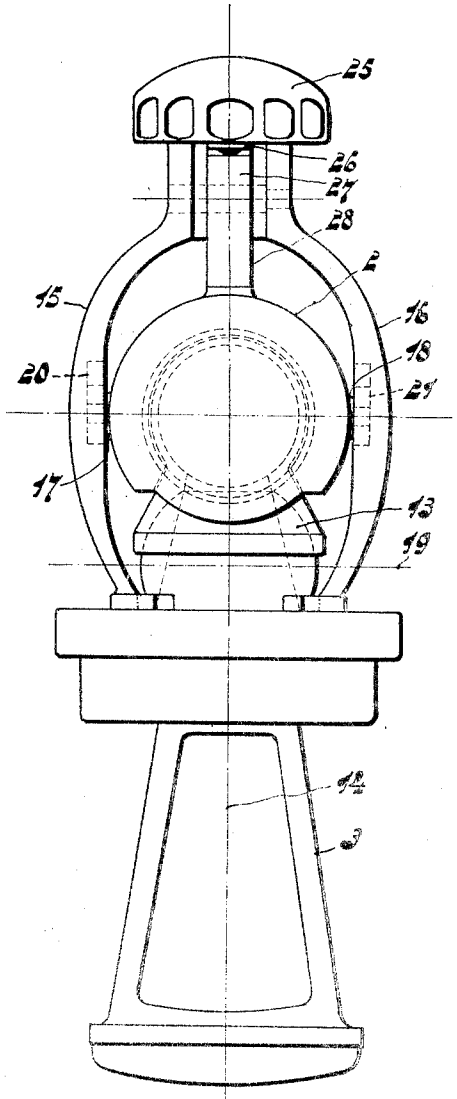

Fig. 2.

INVENTOR
DETLOF EMANUEL BERGGREN

BY Lee B. Kennon
ATTORNEY.

Patented Feb. 14, 1950 2,497,755

UNITED STATES PATENT OFFICE

2,497,755

X-RAY TUBE WITH MOVABLE DIRECTING CONE

Detlof Emanuel Berggren, Eindhoven, Netherlands, assignor, by mesne assignments, to Hartford National Bank and Trust Company, Hartford, Conn., as trustee

Application May 10, 1946, Serial No. 668,707
In the Netherlands June 19, 1941

Section 1, Public Law 690, August 8, 1946
Patent expires June 19, 1961

3 Claims. (Cl. 250—61.5)

1

When treating with X-rays it is desirable that it should be possible for the direction of the cone of rays emitted by the tube to be greatly varied in order that the cone of rays may be moved into an optimum position relatively to the members to be subjected to radiation without the need for the body of the patient to be moved into various undesired positions. If the radiation is carried out with a small X-ray tube the latter is generally adapted to move in such manner that any desired direction of rays can be obtained without much trouble. In larger systems in which the tube is not adapted to move in so many ways it is necessary to conform the position of the body of the patient to that of the tube and this often limits the possibilities of radiation.

As a rule, vertical shifting of the tube is possible and also rotation of the tube about its own axis or, if this latter possibility is not provided for, rotation of the localiser about the axis of the tube. Rotation of the tube about an axis normal to the plane passing through the axes of the tube and the cone of rays is frequently impossible. Substantially such movement is always impossible with apparatus in which the tube extends forward from a vertical wall behind which the electric system is arranged. In the tube whilst being adapted to be raised and lowered and rotate about its own axis cannot rock. Indeed, if this possibility were provided for it would often still be impossible to bring the focal spot sufficiently near to the member to be subjected to radiation since the tube would be in the way of the body of the subject.

The present invention attends to the need for choosing the direction of the cone of rays so as to be optimum. It relates to an X-ray tube provided with a protective sheath, the localiser being movably secured to this sheath. According to the invention, the localiser is so secured to the sheath as to be adapted to rock around an axis inclined at right angles to the axis of the X-ray tube. In order to prevent the axis of the localiser from falling outside the focal spot of the X-ray tube during this rocking movement care is taken that the localiser is subjected at the same time to a translation in the axial direction of the tube.

In order that the invention may be clearly understood and readily carried into effect one practical example of a construction according to the invention in which various further amendments have been made will be described hereinafter with reference to the accompanying drawings, in which

Fig. 1 is a longitudinal sectional view of a

2

portion of an X-ray tube and its protective sheath and localiser.

Fig. 2 is a front elevation of the same parts.

In these drawings the X-ray tube is designated 1, the protective sheath 2 and the localiser 3.

The X-ray tube is of the type in which only the cathode is insulated from earth to withstand high tension and the anode, which is arranged entirely at the end of the X-ray tube, is connected to earth when the tube is in use. The anode is constituted by a copper disc 4 which is set to form an angle of 45° with the axis and constitutes the bottom of a metal tube 5 forming part of the wall of the exhausted discharge vessel. On its inside surface the copper disc 4 carries a small plate 6 of tungsten which is struck by a beam of electrons and on which the focal spot is formed at 7. The tube wall 5 and the anode 4 are enclosed with a small intermediate space 8 by a sheath 9. The intermediate space 8 may have circulating in it a liquid which conducts away the heat evolved in the anode while the tube is in use. The sheath 9 has a lead coating 10 which prevents X-rays from emerging in undesirable directions.

Figure 1 only shows the front part of the X-ray tube. It extends to the left and is carried by a support or is fixed to a wall in such manner as to be adapted to be raised and lowered parallel with itself and to be rotated about its axis 11. These movements permit the axis of the cone of X-rays, the centrally, to be rotated about an axis capable of being shifted parallel with itself. The invention also permits of the central ray being rotated about an axis normal to the former so that this ray can be caused to move through any point of the space.

In the construction shown in the drawing the protective sheath 2 is provided with a slide 12 which is adapted to shift endwise axially of the X-ray tube and in which the localiser 3 is pivoted at 13. The support in this movable slide ensures that the localiser can be subjected to a translation and the pivot 13 enables the rocking movement. The use of means enabling the two movements to be effected simultaneously in dependence on each other ensures that the axis of the localiser 14 which determines the location of the central ray is always directed towards the focal spot 7.

The said means include a directional arm which is secure to the localiser which in the practical construction shown is arranged for to be double and comprises the parts 15 and 16. This directional arm follows the rocking movement of the localiser and during the shifting of the slide 12 is controlled, by means of the guide of a pin in a

slot, by that part of the sheath 2 which is not adapted to shift axially of the X-ray tube, the stationary part, in such manner that the axis of the localiser is always directed towards the focal spot.

If for this guiding a slot were formed in the sheath and a pin fitting into it were provided on the directional arm the place of the localiser would be governed by the pivot and the slot. In such case the slot would have a curved shape comprising two symmetrical curves inclined to each other at an acute angle. The construction is simplified if, as in the practical example, the stationary part of the sheath 2 has a laterally projecting pin 17, 18 whose axis passes through the focal spot and is parallel to the axis of rocking 19, this pin fitting into a slot 20, 21 formed in the directional arm parallel with the axis of the localiser.

When the localiser is moved it rotates in the slide about the axis 19 and at the same time the slide 12 performs an endwise shifting movement due to the directional arm 15, 16 being retained by the pins 17 and 18 and the pivot of the localiser being forced to shift along the line 22.

The localiser might be arranged to be adapted to rotate about an axis passing through the focal spot. In this case, however, during the rocking movement the opening of the localiser is shifted relatively to the sheath not only in a direction parallel to the axis of the tube but also in a direction normal thereto and it becomes more difficult to keep the connection of the localiser to the sheath ray tight. In a device according to the invention this latter condition is achieved by causing the localiser to rock outside the tube.

The pivot may be socket-shaped so as to permit of the localiser being removed from the slide. In the construction comprising a straight slot in the directional arm and a pin on the sheath the position of the localiser is thus not yet entirely determined because the pivot and the slot do not oppose a movement in the axial direction of the localiser. For this reason the practical example which is provided with such a rocket-shaped pivot comprises a runway 23 on the other side of the sheath 2, said runway carrying a relatively movable member 24 secured to the directional arm 15, 16. This runway prevents the localiser from being lifted off the slide. It has such a curved shape that the distance of the centre of the sliding piece 24 at any point of the runway from the line of shifting 22 measured along the line passing across the point 7 is identical.

Friction and wear of the sliding piece and the runway are reduced by the former being constructed as a roller adapted to rotate about an axis. It would yet be efficient if great friction were provided for, because in this case the position of the localiser would not be altered by any light lateral pressure. This need may be attended to by providing a clamping device on the directional arm. In the practical example the clamping device is formed by a screw 25 arranged in the bridge-piece 26 by which the two parts 15 and 16 are united. This clamping device permits of the sheath 2 being clamped to the localiser between the pivot plane on one side and the pressure surface 27 of the clamping device on the other side.

This pressure surface may also serve as a runway during the rocking motion but in this case it is not so simple to construct the sliding piece in the shape of a roller. It is therefore more efficient to provide the sheath 2 with an

arc-shaped cam 28 whose upper side constitutes the pressure surface 27 for the clamping device and which has recessed in it an arc-shaped slot 29 in which the roller 24 moves. The latter rolls over the lower side of the slot 29 with slight friction so that the localiser can be readily shifted. Once the localiser is moved into the desired position the screw 26 is slightly tightened and the localiser is thus clamped.

In order to assist in the shifting of the slide in the sheath its diameter is slightly smaller than the internal diameter of the sheath and the slide is surrounded by two bushings 30 and 31 which slide over the cylindrical inner surface of the sheath and may be resilient.

The sheath must have an elongated aperture so as to give the localiser sufficient range but in so far as this aperture is wider than the localiser it is screened from the X-rays by the slide.

Fig. 1 shows the localiser at one of its extreme positions. By dotted lines the other extreme position is also indicated. The stationary part of the sheath 2 projects some distance from the X-ray tube in order to enable the slide to move aside to such extent as is necessary for the rocking of the localiser. The location of the slide whilst the localiser occupies its second extreme position is also designated by dotted lines.

Fig. 2 shows the localiser at its mid-position. It may also be seen from this figure that in the practical example the pivot is given the shape of a ball and socket joint. This is not essential for the obtainment of the desired rocking, for which a cylindrical pivot would be sufficient, but it serves to enable the localiser to be pulled firmly into the socket more easily by means of a clamping device and to prevent X-rays from emerging on all sides through jars.

What I claim is:

1. X-ray apparatus comprising an X-ray tube provided with a target and having a longitudinal axis passing through the target, a fixed housing for the X-ray tube, a beam localizing member having a beam axis intersecting the longitudinal axis of the tube in a focal spot on the target, a slide member movable parallel to the longitudinal axis of the tube, means to rotatably couple the beam localizing member to the slide comprising two interfitting members connected to the slide member and the beam localizing member respectively which constitute a pivot, and means coupling the beam localizing member to the fixed housing for pivoting the beam localizing member about an axis perpendicular to the longitudinal axis of the tube and passing through the focal spot, whereby the axis of the beam localizing member always passes through the focal spot for all positions of the beam localizing member.

2. X-ray apparatus comprising an X-ray tube provided with a target and having a longitudinal axis passing through the target, a fixed housing for the X-ray tube, a beam localizing member having a beam axis intersecting the longitudinal axis of the tube in a focal spot on the target, a slide member movable parallel to the longitudinal axis of the tube, means to rotatably couple the beam localizing member to the slide member comprising two interfitting members connected to the slide member and the beam localizing member respectively constituting a ball and socket joint, and a supporting member for the beam localizing member pivotally secured to the housing including a pin member movable in a slot of said supporting member and a roller member movable along a

cam surface of the housing whereby the beam localizing member is rotatable about an axis perpendicular to and intersecting the longitudinal axis of the tube in the focal spot and the axis of the beam localizing member always passes through the focal spot for all positions of the beam localizing member.

3. X-ray apparatus comprising an X-ray tube provided with a target and having a longitudinal axis passing through the target, a fixed housing for the X-ray tube, a beam localizing member having a beam axis intersecting the longitudinal axis of the tube in a focal spot on the target, a slide member movable parallel to the longitudinal axis of the tube, means to rotatably couple the beam localizing member to the slide member comprising two interfitting members connected to the slide member and the beam localizing member respectively constituting a ball and socket joint, and a supporting member for said beam localizing member pivotally secured to the housing, including a pin member secured in the housing and slideable in a slot in the supporting member and a roller member movable in an arcuate guide secured to the housing whereby said beam localizing

member is rotatable about an axis perpendicular to and intersecting the longitudinal axis of the tube in the focal spot and the axis of the beam localizing member always passes through the focal spot for all positions of the beam localizing member.

DETLOF EMANUEL BERGGREN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
981,256	Fullerton	Jan. 10, 1911
1,771,759	Kress	July 29, 1930
2,110,764	Graves	Mar. 8, 1938
2,144,524	Charlton et al.	Jan. 17, 1939
2,362,816	Harker	Nov. 14, 1944

FOREIGN PATENTS

Number	Country	Date
391,384	Germany	Mar. 3, 1924
341,301	Germany	Sept. 29, 1921
27,133	Great Britain	Aug. 18, 1904
417,710	Germany	Aug. 15, 1925