United States Patent

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[72] Inventor Andre Massiot
Saint-Cloud, France

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[73] Assignee U.S. Philips Corporation
New York, N.Y.
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Continuation of application Ser. No. 774,546, Nov. 8, 1968, now abandoned, Continuation of application Ser. No. 493,429, Oct. 6, 1965, now abandoned.

[54] COLUMN SUPPORT FOR X-RAY APPARATUS
7 Claims, 2 Drawing Figs.

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[51] Int. Cl. H01j 5/48, H01j 39/12
[50] Field of Search 250/52, 57, 58, 61.5, 91, 92

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Primary Examiner—William F. Lindquist
Attorney—Frank R. Trifari

ABSTRACT: A stand for an X-ray apparatus includes a column, an arm vertically movable on the column, and a carriage supported by the arm. The carriage carries an X-ray tube and a detector and is rotatable about a horizontal axis and about an intersecting vertical axis. Also, the X-ray detector is movable toward the X-ray tube along a third axis which intersects the other axes and is perpendicular with the vertical axes.

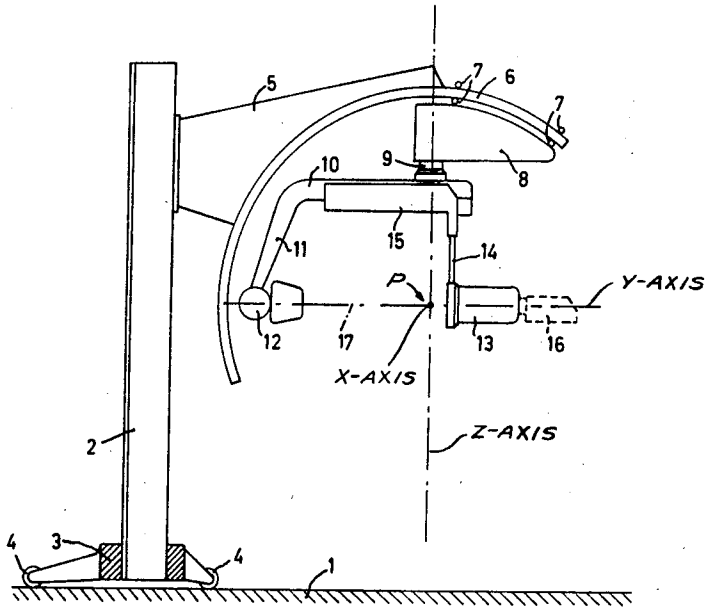
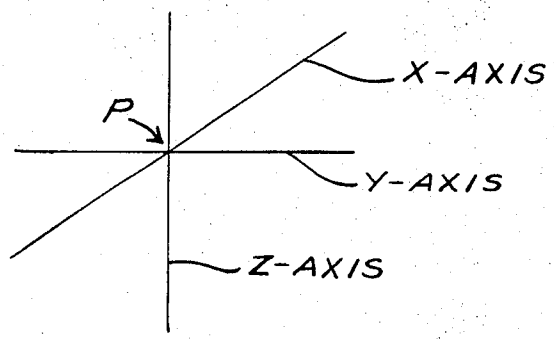


FIG. 2.



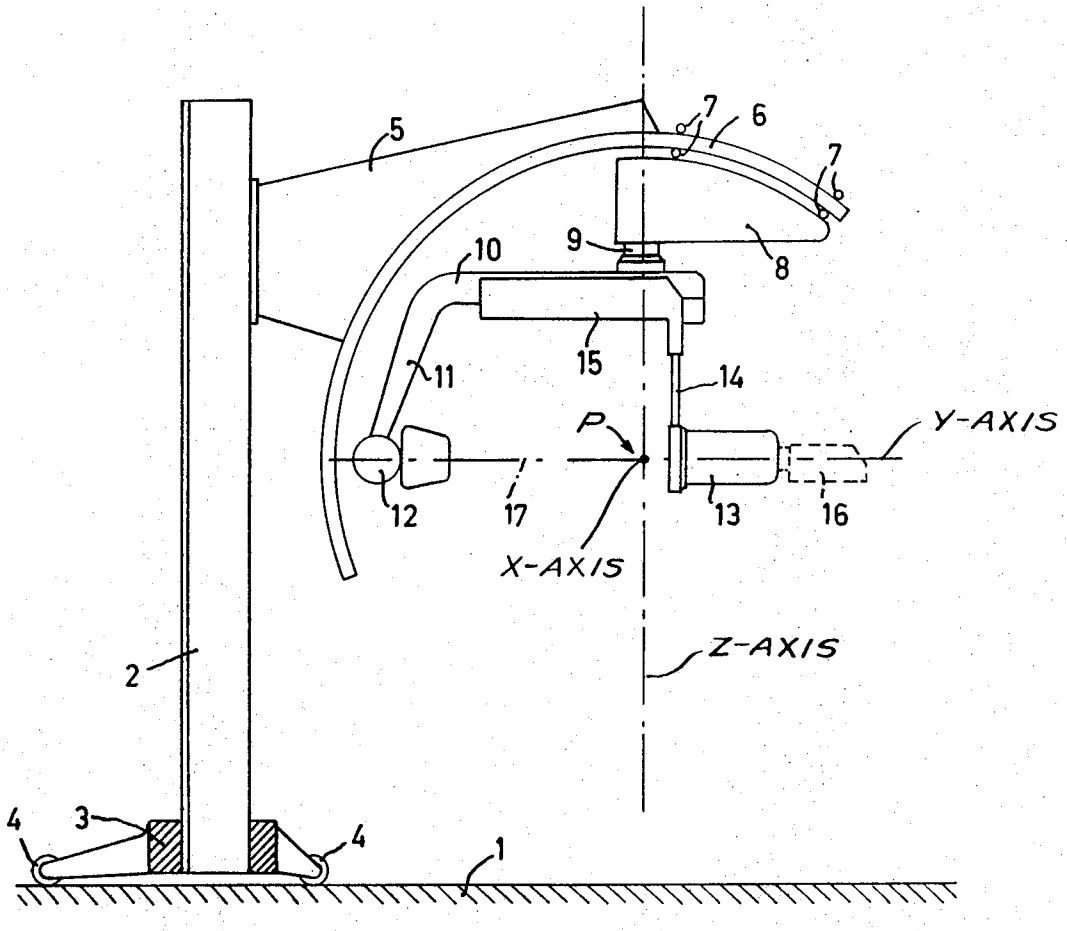


FIG. 1.

INVENTOR.
ANDRE MASSIOT

BY
Francis K. Lincoln
AGENT

COLUMN SUPPORT FOR X-RAY APPARATUS

This application is a continuation of the now abandoned application, Ser. No. 774,546, filed Nov. 8, 1968, which was a continuation of the now abandoned application, Ser. No. 493,419 filed Oct. 6, 1965.

For screening and for recording images with the aid of X-rays, in medical examination, it is often required that adjustments of the X-ray beam can be obtained in which the direction of the central axis of the X-ray beam is chosen quite at will. In order to localize foreign bodies or for defining other positions, it is desirable to penetrate the object in various directions, which processes require a great accuracy. For this purpose it is known that at different adjustments of the X-ray tube and the ray collector the main ray of the X-ray beam is directed through a given point, which condition is fulfilled when the X-ray tube and the ray collector can be displaced in common about two axes at right angles to each other the point of intersection of which lies in the main ray of the beam between the X-ray tube and the ray collector.

Known devices for carrying out such an examination consist of a column stand provided with a horizontal supporting arm which has a circular cross section and which is rotatably secured to the column. With the supporting arm is movably connected a support for the X-ray tube and the ray collector. The movability of the support does not influence the location of the point of intersection of the main ray of the X-ray beam with the axis of rotation of the arm, since this support moves about an axis passing through this point of intersection at right angles to the axis of the supporting arm.

In case of absence of clearance between the various movable parts, a high degree of accuracy may be attained in performing an examination. The accuracy is at a maximum when the position of the point of intersection of the central axis with the two axes remains unchanged while choosing various adjustments of the central axis. Without much trouble, the connections can be established substantially without any clearance, but when a rotatable arm is used, it is not so easy to manufacture the latter so that sagging as a result of the weight of the parts connected thereto is completely avoided. The cause of an insufficient rigidity of the supporting arm must be considered to be the use of an electronic image intensifier with or without an image-recording camera replacing the X-ray screen or the film-holder, which results in a considerable increase in weight.

The invention has for its object to avoid this disadvantage and relates to a column stand for supporting the support of an X-ray tube and an X-ray detector consisting of an electronic image intensifier tube combined or not combined with an image-recording camera, the support being adapted to move about two axes at right angles to each other which have a common point of intersection with the central axis of the X-ray beam, which point of intersection is located between the X-ray tube and the X-ray detector. According to the invention, a horizontal supporting arm is rigidly secured to the column stand or to a carriage displaceable along the column, which arm has a circularly curved end face the length of which is at least equal to a quarter of a circle and the center point of which coincides with the point of intersection of the central axis with the two axes, while a sliding member is displaceable along this end face, which member is provided with a rotary shaft facing the point of intersection and connecting the support of the X-ray tube and the X-ray detector with the sliding member.

The invention will now be described more fully with reference to the accompanying drawing which illustrates a column stand in accordance with the invention in FIG. 1 and a corresponding axis diagram in FIG. 2.

On the floor 1 of a room there is arranged a column 2 on a base 3 which is displaceable by means of rollers 4 along the floor 1. A supporting arm 5 is fixedly secured to the column 2. This manner of securing the supporting arm has the advantage that the dimension may be large in the operative direction of the weight of the movable parts so that any sagging due to the mechanical load is prevented.

The end of the supporting arm 5 remote from the column is provided with a curved end face 6 which constitutes the running face for the rollers 7 by means of which the sliding member 8 can be moved back and forth along the curved path so that it can occupy along the circumference of a quarter of a circle any selected position.

The support 10 is rotatably secured to the sliding member 8 by means of a shaft 9, which support has a bent arm 11 to which the X-ray tube 12 is secured. The ray collector 13 is connected by a holder 14 with a carriage 15 which is displaceable along the support 10, as a result of which the distance from the X-ray tube can be varied by the displacement of the X-ray detector 13. The ray collector is constituted by an electronic image intensifier known per se, while an image-recording camera 16 may be connected thereto.

The beam of rays of the X-ray tube 12 is directed towards the X-ray detector 13 in the direction of the central axis 17 which is coplanar to the center line of the shaft 9 and the point of intersection of which is at the same time the center point of the curved end face 6. The displacement of the sliding member 8 along the face 6 causes the support 10 together with the X-ray tube 12 and the X-ray detector 13 to rotate about an axis at right angles to the said face passing through the point of intersection in the central axis 17. The common displacements render it possible for the X-ray tube to be displaced along a spherical surface so that the central axis can be adjusted in many possible directions.

What is claimed is:

1. A stand for an X-ray apparatus, with parts thereof movable relative to three axes, *x*, *y* and *z*, of which the *x* axis is always horizontal, comprising:
   a. a frame member,
   b. an arm extending laterally from the frame member in fixed orientation, the arm having at one part thereof, a concave curved surface defining a partial circular arc that opens generally downward when the apparatus is erect, the arc having at its center of curvature the *x* axis,
   c. a slide movable along said circular arc and about the *x* axis,
   d. a support and an X-ray source thereon,
   e. a carriage and an X-ray detector thereon, the carriage slidably engaged to the support for providing an X-ray beam from the source to the detector along the *y* axis,
   f. a joint pivotal about the *z* axis for connecting to the slide the subassembly of support, carriage, source and detector,
   g. the source and detector being disposed and relatively positionable at selected distances along the *Y* axis which intersects the *X* and *Z* axes at point P between the source and detector, the central beam of the X-ray source being coincident with said *Y* axis,
   h. said subassembly defining a generally C-shaped unit which is rotatable via said pivot junction about the *z* axis, as the *z* axis is pivotal about the *x* axes when the slide moves on the arc.

2. Apparatus as defined in claim 1 wherein said X-ray detector further comprises an electronic image-intensifier tube.

3. Apparatus as defined in claim 1 wherein the frame comprises a generally upright column from which the arm extends transversely.

4. Apparatus as defined in claim 3 wherein said arm is movable generally vertically on the column.

5. Apparatus as defined in claim 3 wherein said arm is rigidly secured to said column.

6. Apparatus as defined in claim 1 wherein said C-shaped subassembly defines a middle part and two leg parts which extend generally downward.

7. A stand for an X-ray apparatus with parts thereof movable in relationship with *x*, *y*, and *z* axes, comprising:
   a. a frame member,
   b. an arm extending from the frame member, the arm having, at one part thereof, a concave curved surface defining at least a one-quarter circular arc having a center of

curvature about the x axis and generally downward when the apparatus is erect,

c. a slide movable along said circular are,

d. a support and an X-ray source thereon,

e. a carriage and an X-ray detector thereon, the carriage slidably engaged to the support with the source and detector central axis aligned and movable along the y axis, and

f. a joint pivotal about the z axis for connecting the subassembly of support, carriage, source and detector with the slide, the z axis of the joint always perpendicular to the y axis of the source and detector, and the z axis always intersecting the x axis and the y axis at a single point of intersection.

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