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[54] **CLOSED-CIRCUIT-TV-X-RAY MICROSCOPE**

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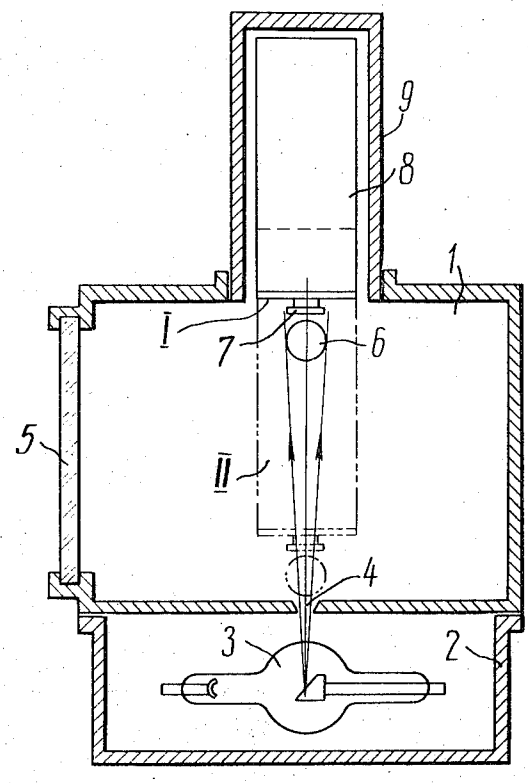
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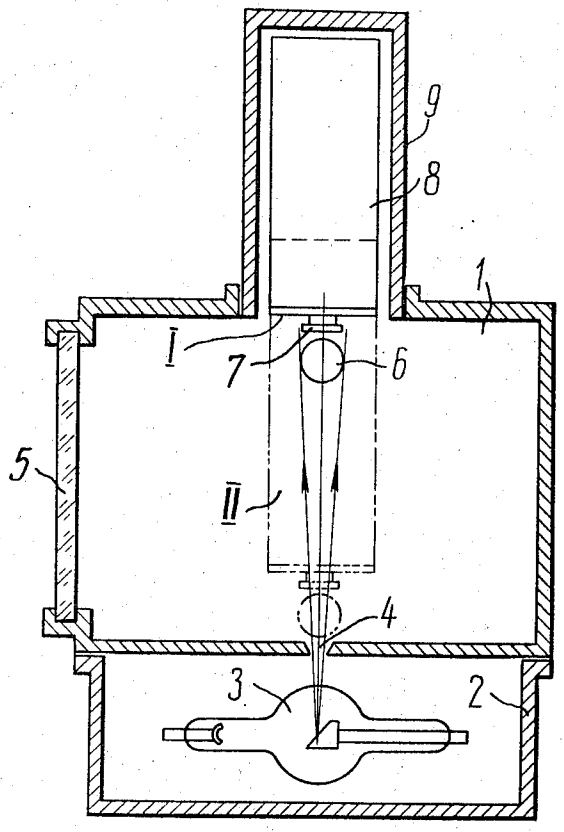
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[57] **ABSTRACT**

Closed-circuit TV fluoroscopic equipment, such as X-ray microscopes of reduced physical size and improved performance, in which X-ray source is enclosed in shielding capsule and a shielding chamber containing object to be X-rayed is positioned on an X-ray beam intercept path relative to a signal converter for adjustment of X-ray intensity and object-to-target distance.

1 Claim, 1 Drawing Figure




9
8
1
I
7
6
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II
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CLOSED-CIRCUIT-TV-X-RAY MICROSCOPE

The present invention relates to closed-circuit-TV fluoroscopic equipment with magnification (closed-circuit-TV X-ray microscopes) and is intended for direct observation in a magnified form of the internal structure of opaque objects on a TV screen and also for a variety of studies of opaque objects, mainly for the non-destructive detection of hidden microscopic defects in various electronic devices.

Broadly known in the art are closed-circuit-TV X-ray microscopes which have a shielding capsule enclosing an X-ray source, and an object chamber in which the path of x-rays is consecutively intercepted by the object being viewed and a converter of X-ray shadow images into TV signals. An enlarged image of the internal structure of the object appears on the screen of a closed-circuit TV monitor which is electrically connected to the X-ray to TV signal converter.

The actual position of the object being X-rayed can be verified through an inspection window in the object chamber while the displacement of the object relative to the target of the signal converter and the X-ray source is effected by a variety of mechanism, fixtures and manipulators.

The basic performance characteristics of a closed-circuit-TV X-ray microscope, such as the resolution, the contrast sensitivity and the range of thicknesses that can be examined are all governed by the amount of X-rays reaching the object and— as a shadow image — the target of the X-ray to TV signal converter. Since existing X-ray tubes provide for the adjustment of X-ray dose within narrow limits only, the gap is usually bridged by varying the distance from the converter target to the X-ray tube. In existing types of closed-circuit-TV X-ray microscopes this is done by moving the X-ray tube towards the converter.

Such a design suffers from a number of disadvantages such as the complexity and unwieldiness of the mechanisms effecting the displacement of the X-ray tube and, as a consequence, the considerable size of the entire closed-circuit-TV X-ray microscope.

It is the object of the present invention to simplify the dose-adjustment system in such a way that with the same useful volume of the object chamber it will be possible to reduce the size of the entire closed-circuit-TV X-ray microscope and to make it more convenient to use and service.

With these and other objects in view, in a closed-circuit-TV X-ray microscope incorporating an X-ray source enclosed in a shielding capsule and a shielding object chamber inside which the object to be X-rayed is placed so that it intercepts the beam of X-rays before thay reach the target of an X-ray to TV-signal converter, the said converter is, according to the invention, placed in an enclosure attached to the object chamber so that there is a possibility for controlled displacement along the beam of X-rays into the object chamber for adjustment of X-ray dose and of the object-to-target distance. It is preferable to have the converter permanently attached to the enclosure which can be moved into the object chamber.

In order to have a wider range of dose adjustment, it is advisable to use a sharp-focused X-ray tube located close to the object chamber and of a converter which can be moved for nearly all depth of the object chamber, so that the distance between the X-ray tube and the converter target can be varied by a factor of 2.5–3.

The embodiment of a closed-circuit-TV X-ray microscope in accordance with the present invention offers the following advantages.

The placement of the converter outside the object chamber in a separate enclosure has increased the volume which can be used for manipulations of large-size objects and has reduced the overall dimensions of the microscope as a whole owing to the reduction of the space occupied by the chamber and required for the movement of the X-ray tube.

The manipulation of the object in the course of X-raying has been considerably simplified, for, according to the invention, instead of moving the object to the converter target by a suitable mechanism, the converter itself is moved inside the object chamber until the object to be X-rayed is in the requisite position.

The invention will be best understood by reference to the description of a preferred embodiment when read in connection with the accompanying drawing which shows a cross-sectional sketch of a closed-circuit-TV X-ray microscope, according to the invention, with a converter movable inside the object chamber.

Referring to the drawing, there is a closed-circuit-TV X-ray microscope having an object chamber **1** and a shielding capsule **2** which holds an X-ray source **3.**

The object chamber **1** is permanently attached to the capsule **2.** The wall of the object chamber **1,** adjacent to the capsule, has a port **4** to pass X-rays, while in the side wall there is an inspection window **5** to watch the position of an object **6** being X-rayed and a target **7** of a converter **8** of shadow X-ray images into TV signals.

X-rays, on passing through the object **6,** form a shadow X-ray image of the object on the target **7.** The converter **8** is permanently mounted in an enclosure **9** attached to the object chamber **1.** The position of the converter **8** relative to the X-ray source **3** can be adjusted by shifting the enclosure **9** into the object chamber, for which purpose there is a rack-and-screw movement (omitted in the drawing). In this way, the converter may be shifted to any position between the extreme ones (I and II, respectively, in FIG. **1**).

Thus embodied, the microscope provides for an increase of ten times in the dose of X-rays reaching the object.

What is claimed is:

1. A closed-circuit-TV X-ray microscope, comprising; an X-ray source; a shielding capsule containing said X-ray source; a shielding object chamber having a common wall with said shielding capsule; an aperture in said wall for passing an X-ray beam from said X-ray source into said shielding object chamber; a converter for converting X-ray shadow images of an object located between said source and said converter into TV signals, said X-ray-TV converter and said object adapted to be positioned in said object chamber in the path of the X-ray beam and being movable along the axis thereof; and an enclosure permanently connected to said object chamber and extending through an aperture therein, said X-ray-TV converter being rigidly supported within said enclosure, said enclosure and the X-ray-TV converter supported therein being jointly movable through said aperture into said object chamber.

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