May 9, 1939. G. A. LINDSTEDT 2,157,491

DEVICE FOR SCREENING-OFF SECONDARY X-RAYS

Filed April 24, 1937

Fig. 1

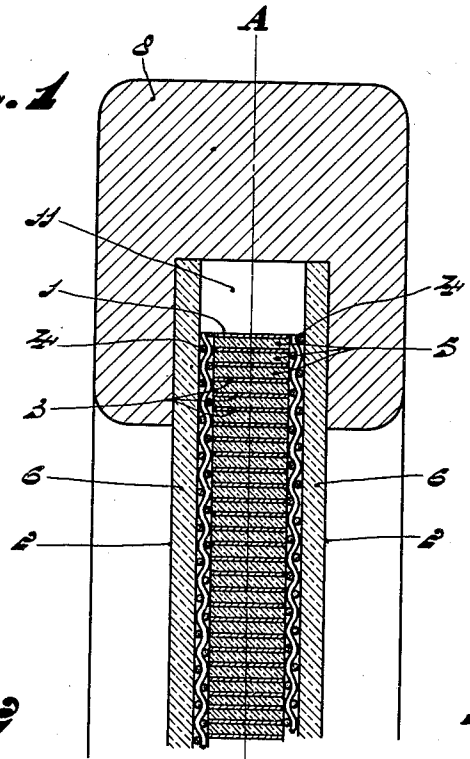


Fig. 2

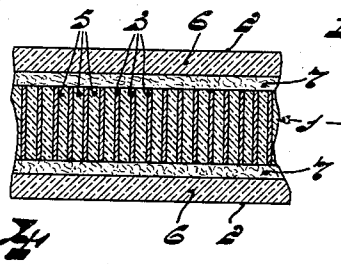


Fig. 3

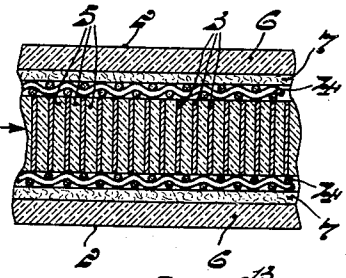


Fig. 4

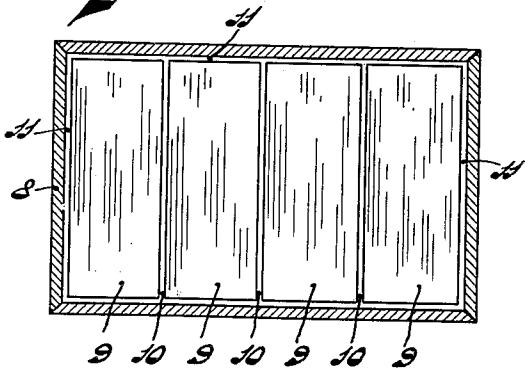
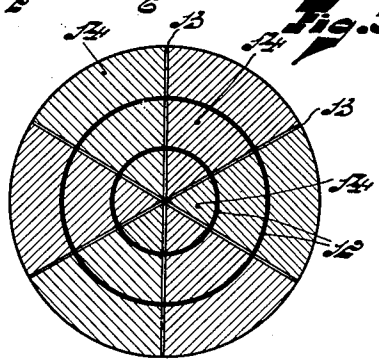


Fig. 5



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DEVICE FOR SCREENING-OFF SECONDARY X-RAYS

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11 Claims. (Cl. 250—63)

My invention relates to a device for screening-off secondary X-rays.

The primary object of my invention is to provide means for preventing curvature and detachment of the screening device due to temperature variations or humidity.

A further object of my invention is the provision of a novel device for the purpose set forth which will not cast inconvenient shadows.

A still further object of the invention is a screening device of such a construction that it need not be moved to sweep out the shadows during operation in radiography.

In carrying out the invention I make a plate-shaped grid body comprising strips of an X-ray impervious material longitudinally arranged side by side and alternating with intermediate spacing layers of a material transparent to X-rays. The strip of X-ray opaque material will preferably be made of lead. As a material for the intermediate layers I prefer to use paper or similar fibrous material. However, the materials most suitable for this purpose are sensitive to temperature variations and liable to the influence of humidity. Consequently the screen body will vary its surface area under the influence of temperature variations or the action of humidity.

In order to obtain a screen which will not cast inconvenient shadows on the photographic plate even when not moved during the exposure, I compose the plate-shaped body of very thin strips, having only a small width. Consequently the body formed by the joined strips and intermediate layers has not sufficient rigidity for practical use. Therefore I provide this body on either side with a reinforcing cover of a material transparent to X-rays.

However the dilation and shrinking of the composite body forming the interior part of the screening device would cause the coatings to become loose from the cover or would give rise to curving. For the purpose of preventing these detrimental actions I use covers which permit the grid body to change its surface area.

My invention will be more fully understood by reference to the accompanying drawing, in which

Figures 1, 2 and 3 are sectional views on an enlarged scale of portions of screening devices according to the invention; and

Figures 4 and 5 are plan views of screening devices according to the invention.

Referring to Fig. 1 of the drawing, 1 represents the inner portion of a screening device, which is sandwiched between stiffening covers 2. The portion 1 is a grid made of strips 3 of X-ray absorbing material, preferably of lead, and of intermediate layers 5 of a material transparent to X-rays. The strips and intermediate layers are connected to each other by pasting. I prefer to use paper or similar moisture absorbing material for the layers 5, which easily absorbs the agglutinant used for the pasting and firmly adheres to the strips 3.

The thickness of the strips 3 may be of the order of 0.1 mm. This small dimension offers the advantage that the shadows of the strips on the X-ray photography, when the surfaces of the strips have the direction of the useful rays, are hardly visible and do not affect the quality of the X-ray image. However, these rays form a divergent beam and therefore will generally not have the direction of the strips.

It is known to so arrange the strips of a screen that they are all directed to the source of the X-rays. This involves difficulties in manufacture since the intermediate layers must have a different size and the strips must be arranged with increasing inclination according as they are situated further from the centre. Another drawback of this construction is that the position of the screen is determined by that of the source of the X-rays.

It is also known to use a screen which is curved about an axis through the source of the rays, but the disadvantages in this case are not less than in the preceding case.

To eliminate these troubles it is common practice to move the screen in such a direction while the exposure is being made that the shadows of the strips are swept out. This requires an additional mechanism and does not prevent the absorption of a portion of the primary rays.

When the width of the strips is extremely small, relatively to the distance from the source their position with respect to the primary X-rays has but little influence on the shadow-lines. Accordingly the width of the strips 3 of my screen may amount from a few millimeters down to 1 millimeter whereby I obtain a screen which needs not be moved during the exposure and does not require a special position with respect to the source of the rays. It also permits a simple manner of manufacture.

I have now found that a grid screen having a flat surface of say 15 square decimeters and a thickness of 1.5 mm. is rather slack and it is therefore advisable to provide, preferably on either side of the screen, a cover made from a material

pervious to X-rays, for example Celluloid. These covers, which serve as a protective means for the screen against mechanical distortion and as a reinforcing element are indicated in the drawing by reference numeral 6.

As stated above, the intermediate layers 5 are made from moisture absorbing fibrous material. As a result they are more or less subject to the influence of the humidity of the air or of temperature variations, especially in tropical regions. The grid body 1 will thereby continuously show slight variations in surface area. The expansion and contraction of the grid body would give rise to undue lateral strains at the joint between the plates 6 and the body 1, if the plates firmly adhered to the body 1. These strains would cause permanent distortion by detachment of the plates, curvature of the screen or damage of the grid. Thus the screen after having been used for some time, would become unserviceable.

I avoid these injurious strains by using covers that permit the grid body to slightly vary its surface area. For example I coat the grid on either side with a flexible layer, shown in Fig. 1 by 4. These layers may consist of fibrous material, such as linen fabric or other yielding material. By these intermediate coatings a slight displacement of the surface of the grid 1 with relation to the plates 6 is rendered possible, without dangerous strains being produced thereby.

For the attachment of the layers 4 a suitable adhesive, either of mineral or organic nature may be used. This adhesive may for instance consist or be produced from resins, synthetic resins, casein, emulsion prepared from vegetable substances, glue or glutinous substances, cellulose or similar substances. It is advantageous to use adhesives that are not affected by humidity from the air and temperature variations.

The tissue or other yielding layer may be secured to the grid at some points thereof or over its whole surface area.

A surrounding metal frame 8, for example of aluminum may be provided to prevent detachment and to protect the screen against bumping, this frame also enhancing the stiffness of the structure.

When relatively large displacements are to be expected, the flexible coatings may not suffice to prevent warping of the screen. In this case I can use the modification shown in Fig. 2. In this modification the tissue or other flexible intermediate layer is substituted by a layer 7 of a plastic adhesive, retaining its plastic consistency for a considerable time. This layer adheres both to the plates 6 and to the grid 1, and keeps them connected but it does not resist against sliding of the surface of the grid relative to that of the plate 6. It may for example consist of rubber solution and may be provided at some points of the adjoining surfaces or throughout the entire surface area.

It is of course possible to combine the modifications of Figs. 1 and 2 and to use both the flexible layers 4 and the plastic layers 7. This combination is shown in Fig. 3. It is especially of use if the adhesion between the agglutinant of the layer 7 and the grid is insufficient to withstand forces tending to draw the plates 6 away from the grid. In this case the layer 4 may be provided to reenforce the grid 1 and the layer 7 to permit sliding of the layers 4 over the plates 6 when the grid dilates or contracts.

With X-ray screens for images having a large size the displacements could still become too wide. The grid may therefore be sub-divided in a plurality of sections spaced from each other so as to allow expansion of each of the sections without pushing on the adjacent sections. Fig. 4 shows this arrangement. It represents a cross section along the plane AB on a reduced scale. The laminations are indicated by parallel broken lines, but cannot be shown individually because they are too thin therefor. The grid is subdivided in four sections 9 with intermediate dilatation slits 10. When the width of each of the sections is for example 10 cm., the slits may have a width of say 5 mm. There is also some amount of play between the inner wall of frame 8 and the sides of the grid lying adjacent thereto. This free gap is also shown in Fig. 1 and denoted by 11.

The screen according to my invention needs not be of rectangular shape. Any other form is possible. In Fig. 5 I have shown schematically a screen of circular shape, having its laminations arranged in a number of sectors. The screen is subdivided in sections by concentric circular interspaces 12, forming dilatation slits and radial interspaces 13 separate the individual sections 14.

The sections 14 are kept in the required position with respect to each other by protective covers as shown in Figs. 1, 2 and 3, these covers thus enclosing the sections and the interspaces, but being in slidable relation with the grid sections so as to permit the latter to freely expand and contract.

What I claim is:

1. A device for screening-off secondary X-rays having a grid comprising strips of lead alternating with layers of moisture absorbing material and a protective cover on either side of said grid, said cover comprising a stiff sheet of a material pervious to X-rays and an intermediate layer of an adhesive, retaining its plastic consistency for a considerable time and permitting some sliding of the grid with relation to the sheet.

2. A device for screening-off secondary X-rays having a grid comprising strips of lead alternating with layers of moisture absorbing material, said grid having a coating of flexible material on either side, a protective stiff sheet on said coating consisting of a material pervious to X-rays and a layer of a plastic adhesive retaining its plastic consistency for a considerable time between said sheet and cover.

3. A device for screening-off secondary X-rays, comprising a fine mesh grid having a plurality of strips of X-ray opaque material and intermediate layers of a material transparent to X-rays, and means to reinforce said grid and to protect the same from mechanical distortion comprising two stiff protective members of X-ray transparent material, said grid being slidably clamped between said members.

4. A device for screening-off secondary X-rays comprising a fine mesh grid having a plurality of strips of lead and intermediate layers of fibrous moisture-absorbing material, and means to reinforce said grid and to protect the same from mechanical distortion comprising two protective sheets of stiff material, said grid being slidably clamped between said sheets.

5. A device for screening-off secondary X-rays, comprising a grid structure having a plurality of laminations of X-ray opaque material and intermediate layers of a material transparent to X-rays, and means to reinforce said grid while permitting free expansion and contraction thereof comprising two stiff protective plates of X-ray

transparent material, said grid being clamped between said plates and slidable with respect thereto.

6. A device for screening-off secondary X-rays, comprising a grid structure having a plurality of lead strips, intermediate layers of a moisture-absorbing material, and an agglutinant holding said strips and layers together, a coating of a yielding material on each side of said grid structure and adhering to the edges of said strips and layers, and two reinforcing plates of X-ray transparent material bearing on said coating.

7. A device for screening-off secondary X-rays, comprising a grid structure having a plurality of strips of lead, and intermediate layers of moisture-absorbing material, layers of flexible fabric secured to the sides of the grid structures, and two protective plates bearing on said fabric, said grid and layers being clamped between said plates.

8. A device for screening-off secondary X-rays, comprising a plurality of grid structures each having a plurality of strips of X-ray opaque material and intermediate layers of a material pervious to X-rays, said structures being spaced apart, a layer of yielding material on the sides of said grid structures, and a protective member of X-ray-pervious material bearing on said latter layers and enclosing the spaces between said grid structures, said structures being clamped between said plates while allowing for the individual expansion and contraction of each structure.

9. A device for screening-off secondary X-rays, comprising a grid structure having a plurality of strips of X-ray opaque material, and intermediate layers of X-ray-pervious material, said structure consisting of a plurality of concentric sections spaced apart to form circular interspaces, a layer of yielding material on the sides of said grid structure, and a protective plate of X-ray-pervious material bearing on each of said latter layers, said grid being clamped between said plates while allowing displacement of each section with respect to said plates.

10. A device for screening-off secondary X-rays, comprising a grid having strips of X-ray-opaque material and intermediate layers of X-ray-pervious material, said grid consisting of a plurality of sections spaced apart to form radial and circular interspaces, a layer of yielding material on the sides of said grid, and a protective plate on each of said latter layers and enclosing said sections and interspaces, said sections being clamped between said plates while allowing displacement of the individual sections with respect to said plates.

11. A device for screening-off secondary X-rays, comprising a grid having a plurality of strips of X-ray-opaque material, and intermediate layers of X-ray-pervious material, and means to reinforce said grid and to protect the same from mechanical damage comprising a layer of yielding material on the sides of said grid, and two protective plates of X-ray-pervious material bearing on said latter layers, and a frame clamping said plates together at their periphery and forming a space at the periphery of said grid to allow for contraction and expansion thereof.

GUSTAV ADOLF LINDSTEDT.