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RADIATION BEAM SHAPING DEVICE

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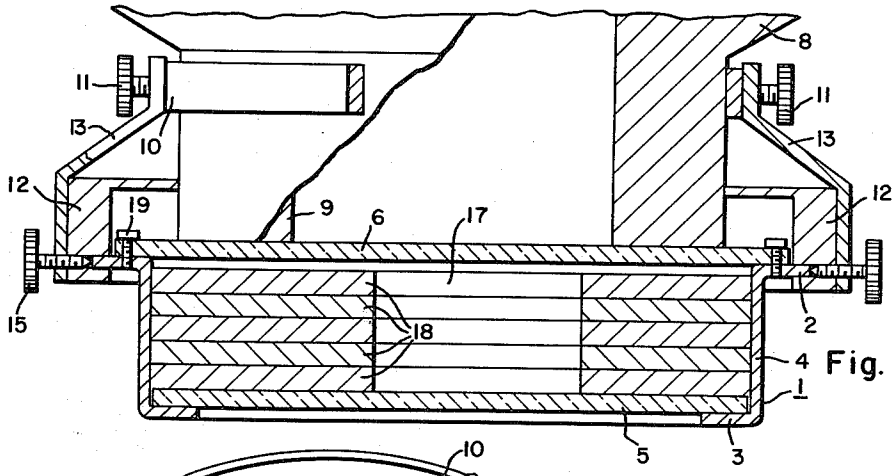


Fig. 1

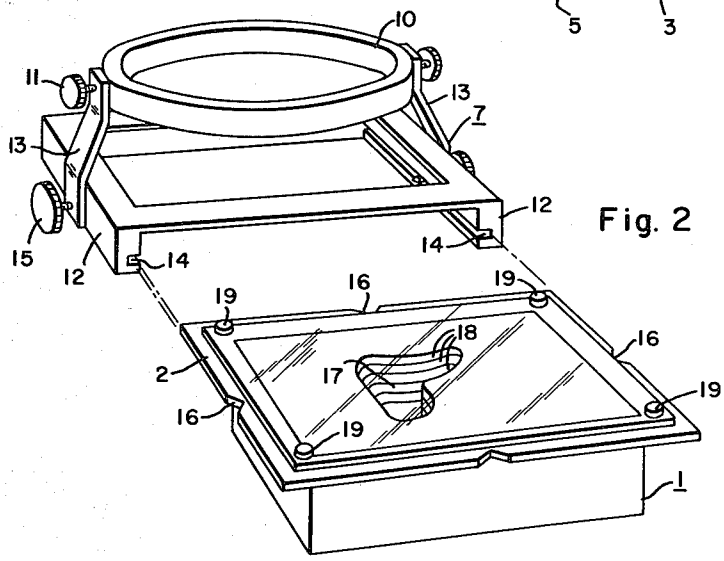


Fig. 2

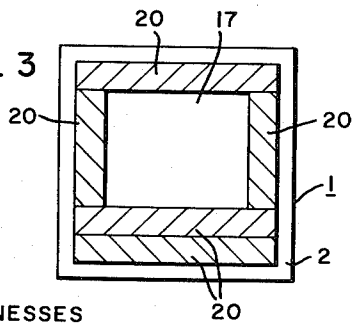


Fig. 3

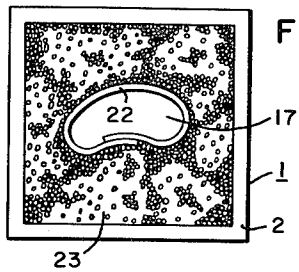


Fig. 4

WITNESSES

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RADIATION BEAM SHAPING DEVICE

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The present invention relates to a radiation beam shaping device and more particularly to such a device as may be employed advantageously for collimation of penetrative radiation from a radioactive source material such as cobalt-60 in a radiation therapy unit.

A collimator is used during radiation therapy to shape the beam to the approximate area of the patient to be treated. In X-ray therapy, lead sheets are placed on the patient to protect non-treated areas from X-ray exposure while defining precise and irregular exposure areas within the cross-sectional area of the X-ray beam formed by the collimator. This technique is satisfactory in X-ray therapy, however, where radiation of considerably greater penetrating power, such as gamma radiation from a radioactive source material (cobalt-60, for example), is employed, lead sheets placed directly on the patient would be too heavy to endure were such sheets thick enough to be effective.

The present invention solves the problem of affording customized selective exposure for different patients in such gamma radiation therapy by provision of beam shaping devices which may be placed selectively at the exit to the radiation emergence aperture of the radioactive source material holder.

An additional object and advantage of the invention resides in the provision of such beam shaping devices which may be readily fabricated from standard components.

Other objects and advantages of the invention will become apparent from the following detailed description of the invention when taken in connection with the accompanying drawings, in which:

FIGURE 1 is a sectional view in elevation showing details of the beam shaping device as attached to the collimator of a radioactive source material holder;

FIG. 2 is a perspective view of the beam shaping device, including adapter means for attachment to the collimator; and,

FIGS. 3 and 4 are plan views of alternate embodiments of the beam shaping device shown in FIGS. 1 and 2.

Referring to FIGS. 1 and 2 in the drawings, the beam shaping device comprises a container member 1 preferably in the form of a rectangular box having top and bottom flanges 2 and 3 extending outwardly and inwardly, respectively, from vertical side walls 4. The bottom flange 3 serves as a ledge for edge support of a transparent bottom member 5, while the top flange 2 serves as a ledge for edge support of a transparent top cover member 6 while at the same time adapting the container 1 for removable support by an adapter member 7 which is adapted to be removably attached to a collimator member 8 associated with a radioactive source material holder (not shown).

The source material holder (not shown), for example, may be substantially like that shown and described in copending patent application, Serial No. 760,791 by Eugene P. Thomas, filed September 12, 1958 and assigned to the assignee of the present application, now Patent No. 3,048,741. Insofar as the present invention is concerned, the radioactive source material holder includes a light source in the form of a focusing lamp bulb (not shown) and a capsule of radioactive material (not shown) which alternately are brought into registry with the uppermost

inlet end (not shown) of a radiation beam emergence aperture 9 defined by the aforementioned collimator member 8. By means of the focusing light, the size, shape and direction of the radiation beam may be indicated visibly by projection of a light image onto the patient via emergence aperture 9 and any beam shaping means at the exit thereof, to thus facilitate beam alignment and selection of the beam shape for proper area exposure during subsequent therapeutic irradiation of the patient upon bringing the radioactive source material into registry with the aperture 9.

In accord with the invention, the container member 1 is adapted to be mounted on the collimator member 8 with relative ease by the provision of adapter member 7 which includes a ring 10 to fit around such collimator member and be secured in place by screw members 11. A pair of parallel-arranged track elements 12 secured to the ring 10 via rigid strap members 13 have slots 14 to receive the flange 2 of such container member, which flange may be aligned with the slots 14 and then slid thereinto for support beneath radiation emergence aperture 9. Set screws 15 on member 7 engage notches 16 in flange 2 to secure container member 1 in place while in use.

To define the beam shape, the invention employs lead insert elements which may be placed into the container member 1 to occupy the space between top and bottom members 5 and 6 at the exclusion of a portion serving as the radiation emergence port 17 which defines the shape and size of the radiation beam.

In the embodiment shown in FIGS. 1 and 2, the lead insert elements take the form of lead sheets 18, each of which has formed therein the port 17, as by cutting or sawing, which are placed into the container member 1 and stacked in a manner which brings each of the respective ports 17 into registry as a continuous port surrounded by the aggregate thickness of the several lead sheets to define the desired beam shape. Following the stacking of the precut lead sheets 18 into a container member 1, the top member 6 may be secured in place on flange 2 by screw members 19.

The alternate arrangement shown in FIG. 3 is particularly suited to the formation of square-cornered radiation beam shapes. In this embodiment, the lead insert elements take the form of solid lead bars 20 of square cross-section and having substantially the same thickness as the depth of container member 1 between top and bottom members 5 and 6. The bars 20 and/or blocks 21 are placed into the container member 1 in support by bottom member 5 and the member and arrangement of these elements chosen to provide the desired shape and size of port 17. The bars or blocks 20 may be faced with strips (not shown) of resilient material to afford a yieldable clamping action between the transparent plastic top and bottom members 5 and 6 for holding the desired pattern during handling of the assemblage following placement and securing of such top member onto container 1.

The alternate embodiment shown in FIG. 4 employs a strip 22 of pliable material, such as lead, which is bent to form an inner retaining wall for lead shot 23 poured into container 1. The strip, formed to agree with the desired shape and size of port 17, is dimensioned to span the distance between top and bottom members 5 and 6, so that following securing of top member 6, the strip 22 and lead shot 23 will be retained in place during handling of this form of the novel beam shaping device.

Each of the aforedescribed forms of the novel beam shaping device may be fabricated with great ease to provide the desired beam shapes which are customized to suit the individual patients. Following their make-up, these devices may be tagged for patient identification and stored for reuse during repeated treatments. A supply

of containers, lead sheets, lead bars, block, lead strips and lead shot may be made available to the radiologist or technician to facilitate the fabrication of these beam shaping devices, and following their periods of usefulness, they may be disassembled for reuse of many or all of their components when desired.

While the invention has been described in the foregoing with a certain degree of particularity, it is to be understod that the invention is not necessarily to be so limited except as defined by the following claims.

We claim as our invention:

1. A radiation beam-shaping device for employment in conjunction with a penetrative radiation source holder having a radiation emergence aperture which is selectively registered with a penetrative radiation source and with a light source, said device comprising a container member having light-transparent top and bottom members, lead insert elements disposed within said container member to form a radiation beam-shaping aperture in extension between said top and bottom members which is of different size and shape than the radiation emergence aperture in said source holder, and means for removably attaching said container member to the source holder at the exit of its radiation emergence aperture.

2. A radiation beam-shaping device for employment in conjunction with a penetrative radiation source holder having a radiation emergence aperture which is selectively registered with a penetrative radiation source and with a light source, said device comprising a container member having light-transparent top and bottom members and being adapted to be removably attached to the source holder at the exit of its emergence aperture, and a laminated assemblage of lead sheet elements disposed in said container member, said lead sheet elements having respective aligned openings formed therein in extension between said top and bottom members to define the shape of the radiation beam leaving said emergence aperture.

3. A radiation beam-shaping device for employment in conjunction with a penetrative radiation source holder having a radiation emergence aperture which is selectively registered with a penetrative radiation source and with a light source, said device comprising a container member having light-transparent top and bottom members adapted to be removably attached to the source holder at the exit of its emergence aperture, and a plurality of lead bars disposed and arranged in said container to define a beam-shaping aperture in extension between said top and bottom members for the radiation beam leaving said emergence aperture.

4. A radiation beam-shaping device for employment in conjunction with a penetrative radiation source holder having a radiation emergence aperture which is selectively registered with a penetrative radiation source and with a light source, said device comprising a container member having light-transparent top and bottom members and adapted to be removably attached to the source holder at the exit of its emergence aperture, a bent strip of pliable material disposed in said container and formed continuously to define a beam-shaping aperture extending between said top and bottom members for the desired radiation beam shape, and lead shot disposed in the void defined by the sides of said container member, the outside of said bent strip and said top and bottom members.

5. A radiation beam-shaping device for employment in conjunction with a source holder having a radiation emergence aperture which is selectively registered with a source of penetrative radiation and a focusing light source, a container member adapted to be removably attached to the source holder at the exit of said emergence aperture, said container member having light-transparent members defining its top and bottom, and a plurality of removable lead insert elements disposed within said container member to form a radiation beam-shaping aperture extending between said light transparent members.

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