X-RAY PROTECTIVE SHIELD HAVING AN APERTURE FOR THE PASSAGE OF INSTRUMENTS MANIPULATED BY THE OPERATOR

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This invention relates to new and useful improvements in movable X-ray protective shields and more particularly to a barrier that permits the operator to remain adjacent to the patient while manipulating instruments within or on the patient through an elongated aperture and yet be maximally protected from the X-rays directed to the patient.

It is well known that over-exposure to X-ray is very critical, leading to cancer, sterility, leukemia, shorter life-span, death, etc. and that the effect of multiple exposures are cumulative. This presents a serious enough problem to patients who can possibly expect several X-rays in a lifetime but far worse to the X-ray technician or physician who spends a lifetime in almost daily operation of X-ray equipment.

Accordingly, various means of protecting the operators have been developed including lead glass for viewing, leaded aprons and gloves for wearing and permanent leaded partitions behind which the operator retires during exposure of the patient. Other devices have also been developed but none previously provided maximum protection to the operator while permitting him to remain and work with the patient during exposure thereof.

Thus it is difficult to work with heavy-leded gloves, much of the body is unprotected by tiring heavy-leded aprons and permanent partitions require absence of the operator at the critical time. Not only does the patient feel apprehensive when the operator leaves, but many exposures must be repeated because of the operator's absence, thus increasing the exposure time and risk to the patient. For example, in cystoscopie examination of the urinary tract with radiographic dyes, the volume and pressure of the dye is critical. To compensate for the time lag between injection and getting behind the protected partition, the operator may inject too much, with consequent discomfort and/or damage to the kidneys. However, if too little is injected, the run-out may leave insufficient contrast media before the exposure is made and require a subsequent exposure.

Therefore, it is an object of this invention to provide a portable protective shield which permits the operator, without risk, to remain adjacent to the patient.

It is also an object of this invention to provide such a shield that permits the operator, without risk, to manipulate instruments within the patient at the time of exposure.

It is another object of this invention to provide such a shield that permits close proximity at all times, including exposure of the patient without risk to the operator.

I have found that a portable shield with a window, all of radiopaque material such as leaded materials of adequate thickness, width and height sufficient to protect the operator from principal or secondary rays, can be provided with a working extension (generally vertically movable) toward the patient of lesser width than the shield to permit easy access to the patient. The working extension is provided with an aperture through which instruments, such as catheters, scopes, needles, syringes, etc., may be manipulated. The aperture may be mounted in the shield without a working extension but it is preferred to have the working extension for convenience in placing items, hands and arms and is also preferable to have the aperture elongated, horizontally split and mounted for universal movement.

With these and other objects and features in view, the nature of which will be more apparent, the invention will be more clearly understood by reference to the drawings, the accompanying descriptive and the appended claims.

In the drawings:

FIG. 1 is a side elevational view of the protective shield, together with working extension constructed in accordance with this invention and showing patient and doctor during the taking of an X-ray;
FIG. 2 is a perspective view of the unit of FIG. 1;
FIG. 3 is a cross-section of a detail on the lines 3--3 of FIG. 2;
FIG. 4 is a cross-section view on the lines 4--4 of FIG. 3;
FIG. 5 is a perspective view of an instrument tray within the working extension with parts broken away;
FIG. 6 is a perspective view of a detail of the instrument tray;
FIG. 7 is a cross-sectional view on the lines 7--7 of FIG. 6;
FIG. 8 is a plan view partly in section of the lock on the instrument tray;
FIG. 9 is an expanded perspective view of an elongated aperture slidable mountable in the instrument tray of FIG. 6;
FIG. 10 is a plan view of a baffle that may be used in the aperture of FIG. 9;
FIG. 11 is a perspective view of a modified elongated aperture that may be slidable mounted in the tray or shield; and
FIG. 12 is a modified end for the tray.

Referring to the drawings, a doctor or X-ray technician is shown in position behind the protective shield and a patient 11 in reclining position on an X-ray table 12 and above the standard film holder 13. In the present case, the patient is shown in position for an examination of the urinary tract while employing a cystoscope with catheters, projected through channel 50, FIG. 9.

The protective shield is provided with a front panel 14, which is of lead or is lead coated to provide maximum protection to the operator. The front panel as shown is of height and width to accommodate an operator, and may be varied as may be desired. Side panels 15A and 15B are provided, and these side panels may be either hinged to the front panel for lateral movement, or may be placed in fixed position, preferably at an angle of approximately 120° from the front panel to provide the necessary protection and to allow for the patient's posture as the entire unit is moved close to the patient at the time of operation.

The front panel 14 is preferably provided with a movable panel 16 which carries a fixed working extension 21 provided with a window 17 of leaded glass (which optionally may be in vertical panel 16). The movable panel 16, which may be substantially the full width of the front panel 14 and may vary in height, but which is preferably approximately two-thirds of the height of the front panel, is mounted for vertical movement in vertical racks 18 fixed on either side of the front panel and running substantially from top to bottom thereof. A pinion gear 18A mounted on the movable panel 16, inside a gear box 19 with a reduction gear, controlled by handle 20 provides means for the operator to raise or lower the movable panel as desired. If desired, counterweights or other similar means may be employed to counterbalance the weight of the movable panel. Pulleys mounted on the front panel 14 and handles on the movable panel 16 may be substituted for 18A, 19 and 20 to vertically adjust the
movable panel and obviously the unit may be driven with a motor. The entire unit is mounted on a plurality of roller casters to provide portability.

Working extension or hood 21 has a front portion 22, which slopes downwardly from the movable panel, and a pair of side shields 23 which cover the area between the movable panel and the front portion 22 of the hood. The front portion of the hood and the two side portions are of lead or are lead coated to provide protection from the X-rays. The front panel of the hood is provided with a window 17 of leaded glass to provide full view of the patient.

A movable tray 25, which is located immediately below and within the hood, is slidably mounted in the movable panel as shown in FIG. 2. This tray is slidably horizontally to front and back on the sliders 26, and may be moved outwardly beyond the outer edge of the front shield 22 by the operator to change the instruments therein. The tray 25 has a front 27, sides 28, a back 29, and a bottom 30. The front 27 is provided with a narrow port 31, cut therein, through which the operator may control instruments such as catheters during an examination of the patient 11. The back 29 of the tray is provided with a handle 32, for use by the operator in moving the tray in and out. If the tray 25 is rotated at one side of the back 29 of the tray provides means for locking the tray when in desired position, and when released, allows the tray to be moved by sliding. Said release handle controls a lock 33A which swings in position in opening 33B in the side of the hood to lock the tray in the desired position. To release the tray, the handle 33 is turned to release lock 33A.

In order that the operator can more easily work with the patient being examined, the front 27 of the tray may be hinged to the bottom 30, as shown in FIG. 6, so as to swing outwardly to a horizontal position (dotted lines, FIG. 1). Thus the operator may be free to work with the instruments placed on the tray through the open front of the tray and when closed enjoyment of the protection provided by the hood from the harmful direct and secondary X-rays. To assure ease of maneuvering, the front 27 of the tray is pivoted with hinges 34 having a pair of springs 35 bearing against the front 27, so as to maintain the front closed when in normal position. A finger plate 36, mounted on the front of the tray, provides an easy means for the operator to push open the front when desired and closed when instruments are inserted.

Port 31 may be further restricted by the cylindrical aperture 50 shown in FIG. 9 which includes a lower lead unit 51 with a half cylinder concavity 52 and an upper lead unit 53 with a matching half cylinder concavity 54. Grooves 55 are provided in both units within which port 31 slides to maintain the unity of the two units 51 and 53. The upper unit may be slidably removed to introduce, remove and change the instruments being used by the operator. The aperture 50 may be completely restricted by a lead plate 59 that is slidably removable from the aperture in a track defined by side rails 56 and bottom rail 57. However, if an instrument is placed in the aperture 50, the plate will slide only to the instrument to substantially close the port except for the space occupied by the instrument. A plurality of plates having different size openings 58 may, of course, be provided that will fit the frame, all of which will obviously be made of radiation-impermeable material.

A further modified restriction for port 31 is that shown in FIG. 11 and includes a split housing 60 adapted to slide into the port 31 by grooves 64. Each half of the housing includes a half cylinder cavity 61 in which is mounted a corresponding cylinder 62 provided with a half cylindrical depression which mates with the opposing depression to form a horizontally elongated cylindrical instrument passage 63. The cylinder 62 is split so that the top half may be removed for insertion or removal of instruments within the passage. (“Instruments” is used here broadly to indicate any item that the operator may want to use, such as catheters, infusion devices, scopes, needles, cannula lenses, syringes, to name only a few.)

The cylinders 62, 63 are obviously mounted to provide a fuller range of movement in the horizontal plane. Vertical movement is permitted by vertical movement of panel 16. Universal movement could be provided with two hemispheres mounted in complete hemispheric cavities, but generally universal movement is neither required nor desired. Sufficient movement will be provided to permit movement of instruments in observing and treating a patient with the apparatus as shown. A relatively small movement at this fulcrom will, of course, permit wide movement of the distal end of an instrument within or at a patient. A plate 59 is also preferably mounted on the housing 60 in tracks not shown.

Although passages 50 and 63 are cylindrical, obviously any cross-section will be acceptable. The critical feature is that the length of the passage should be at least equal to the diameter (or longest measurement transverse to the longitudinal axis) and preferably 1.33 times as long. As a practical matter, the diameter of the passage is preferably not over 0.75 in, and under special circumstances may not exceed about 1 in. In fact, the full diameter of the passage is not essential because the plate 59 further restricts the effective aperture to about the size of the instrument being used. Furthermore, the instrument itself serves to block or reflect X-rays into the lead walls. It will be appreciated that primary rays from the X-ray tubes' useful beam will not be transmitted through passages 50 or 63 parallel to the longitudinal channel axis (see FIG. 1) so that only rarely secondary reflected rays are involved. If any secondary rays are parallel to the channel axis, they would strike the instrument and be deflected into the lead channel wall where they would be absorbed.

The tray 25 may be completely removed and the opening in hood 21 covered by a flexible lead-impregnated material (e.g. Leadflex) 66 shown in FIG. 12 which is provided with an aperture 67. With this modification, the patient may remain behind the shield and extend a leg, arm or head through the aperture 67, which would be particularly applicable to infants, thus reducing the total body radiation and permitting a protected operator to hold the infant during exposure. In addition, the patient from the front of the shield may extend an arm or leg through the aperture 67 for injection or other purposes. Obviously aperture 67 can be changed as needed and could be a mere slit in the fabric.

I claim:

1. A portable protective X-ray shield to be positioned between the portion of the patient being exposed and the operator where the patient and operator are adjacent except for said shield comprising an X-ray opaque panel of sufficient dimensions to protect said operator, said panel being provided with an elongated instrument aperture therethrough not greater than about one inch in diameter and having a length at least equal to about 1.33 times said diameter for the passage of instruments therethrough from the operator's side and having its longitudinal axis disposed at an angle with respect to the path of travel of X-rays from a source thereof, said aperture being lined with X-ray opaque material.

2. A portable protective X-ray shield to be positioned between the portion of the patient being exposed and the operator where the patient and operator are adjacent except for said shield comprising an X-ray opaque panel of sufficient dimensions to protect said operator, said panel having an X-ray opaque hood extending toward said patient for manipulation of instruments and including a front wall parallel to and spaced from said panel, said wall being provided with an elongated instrument aperture therethrough not greater than about 0.75 inch in diameter and having a length at least equal to said
diameter, said aperture being lined with X-ray opaque material.

3. The shield of claim 2 wherein an X-ray opaque plate is slidably mounted adjacent said aperture to cover said aperture if desired.

4. The shield of claim 2 wherein said length is at least 1.33 times said diameter.

5. The shield of claim 2 wherein the elements defining said aperture are split on a horizontal plane for removal and insertion of instruments.

6. The shield of claim 2 in which said front wall is defined by the front wall of an instrument tray slidably mounted within said hood.

7. The shield of claim 2 wherein said hood is movable in a vertical plane.

8. The shield of claim 7 wherein said aperture is mounted for rotation through a horizontal plane.

9. The shield of claim 7 wherein said aperture extends through a vertically extending cylinder that is mounted for rotation in a spaced parallel pair of elongated concave members.

10. A portable protective X-ray shield to be positioned between the portion of the patient being exposed and the operator where the patient and operator are adjacent each other except for said shield comprising an X-ray opaque panel of sufficient dimensions to protect said operator, said panel having an X-ray opaque hood extending toward said patient for manipulation of instruments and including a front wall parallel to and spaced from said panel, said wall including a flexible sheet of X-ray opaque material having an aperture therethrough.

11. The shield of claim 10 wherein said aperture is adapted to fit around a human limb extending there-through.

12. The shield of claim 10 wherein said aperture is a circle.

13. The shield of claim 10 wherein said aperture is a slit.

14. The shield of claim 10 in which said front wall is defined by the front wall of an instrument tray slidably mounted within said hood.

15. A movable shield for protection against harmful rays, comprising a vertical central panel and side members of X-ray opaque material, a front panel of X-ray opaque material mounted in said central panel for movement upwardly or downwardly, said panel having a centrally located protective hood of X-ray opaque material extending outwardly at an angle from the central panel, said hood having a bottom and integral protective side shields of X-ray opaque material and a top including a transparent area of X-ray protective material, a movable tray slidably mounted under said hood and having a front of X-ray opaque material, sides, a back and a bottom, said front having a port therein to accommodate medical instruments and being hinged to the bottom of the tray, and means cooperating with said tray to lock it in fixed position.

16. The shield of claim 15 additionally comprising means for controlling the vertical position of said front panel and means for controlling the horizontal movement of said tray.

17. The shield of claim 15 additionally comprising roller means mounted on said vertical panel to provide mobility.

18. The shield of claim 15 wherein a block is mounted in said port, said block having an elongated instrument aperture therethrough not greater than about 0.75 inch in diameter and having a length at least equal to said diameter, said aperture being lined with X-ray opaque material.

19. The shield of claim 18 wherein an X-ray opaque plate is slidably mounted adjacent said aperture to cover said aperture if desired.

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