ABSTRACT: A primary ray diaphragm for X-ray examining devices has plate diaphragms limiting the ray field, whereby those parts of the plate diaphragms which are adjacent to the ray field being limited have an absorption value producing a half shade effect and corresponding to that of an iron plate having a thickness of 0.4 to 3.5 mm.
ADJUSTMENT APPARATUS FOR X-RAY WEDGE FILTER PLATES

This invention relates to a primary ray diaphragm for X-ray examining devices which has at least one plate diaphragm limiting the field of the rays.

These primary ray diaphragms are mostly used to limit the ray field to the area of the body being examined in order to spare the patient and to diminish stray rays by providing within the ray field several plates which do not transmit the rays. This limitation of the ray field is absolutely necessary in case of operations of extremities with image magnifying remote view control, since otherwise primary rays passing by the extremities and striking directly the light screen would provide at those struck parts of the screen such brightness that the light would move over into the parts of the screen containing the extremities.

Prior art primary ray diaphragm which avoids these drawbacks has four plate screens, whereby each pair of these screens is adjustable in two planes located close one over the other, the adjustment taking place toward each other in directions which are perpendicular to each other and being carried out by separate motor actuated racks, whereby the entire screen support is rotatably mounted around the central ray by a further motor drive.

A drawback of this primary ray diaphragm is that it limits the operational visible field containing the required information, so that instruments which are moved from the side, namely, transversely to the direction of the rays, such as injection needles, knives, guide picks, channels, borers, etc., become invisible when they enter into the limited field. The movement of the instruments from the side and their application are not visible upon the light screen.

An object of the present invention is to provide a primary ray diaphragm which will avoid these drawbacks.

Other objects of the present invention will become apparent in the course of the following specification.

In the accomplishment of the objectives of the present invention, it has been found desirable to improve the primary ray diaphragm of the described type by so constructing parts of the plate diaphragm which are adjacent to the ray field that they have at least partly an absorption value producing a half shade effect and corresponding to that of an iron plate having a thickness of between 0.4 and 3.5 mm. The result is that, despite the limitation of the visible field containing the required information, the doctor can fix the instruments under continuous control of the light screen and can follow their movement up to their appearance in the main visible field. This takes place without any disturbance of the observations of occurrences in the visible field by primary rays moving sidewise along the extremities.

In accordance with an advantageous further development of the present invention, the front surfaces of the parts of the plate diaphragm having limited absorption values extend like a wedge at an inclination to the central ray. This construction of the edges of these parts provides a gradual increase in the weakness of the rays from the edge of the plate diaphragm to its center and thus avoids the appearance of the plate edges as lines upon the light screen.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings, showing, by way of example only, a preferred embodiment of the inventive idea.

In the drawings:
FIG. 1 is a perspective view showing the arrangement of a primary ray diaphragm upon an X-ray examining apparatus; FIG. 2 is a perspective view, partly in section, showing the inner structure of a primary ray diaphragm; FIG. 3 is a perspective view showing a light screen and a remote view picture produced thereon by the use of the primary ray diaphragm of the present invention. FIG. 1 shows an X-ray examining apparatus movable upon wheels 2 and 3, of the type often used in surgery. It contains a box 5 which is movable vertically upon a support 4 and which contains a horizontal longitudinally movable support 6. A holder 7 is mounted upon one end of the support 6 and is rotatable about its axis. A frame 8 having the shape of a half circle is slidably mounted in the holder 9. One end of the frame 8 carries a casing 9 for the X-ray tube, while the other end carries a casing 10 for the image magnifying and remote view device. A primary ray diaphragm 11 carrying a tube 12 is fixed to the X-ray tube casing 9. Flanges 13 and 14 serve for attaching the casings 9 and 10 to the frame of the primary ray diaphragm. A small box 15 attached to the holder 7 contains servicing tools for operating the X-ray examining apparatus.

FIG. 2 shows the casing 19 for the primary ray diaphragm 11 which is fixed to the X-ray tube casing. The side of the diaphragm casing which is directed toward the patient has a diaphragm disc 21 provided with an opening 20 and rotatable around the central ray 22. Bearing stands 23, 24, 25 and 26 are located upon that side of the diaphragm disc which is directed away from the patient. Diaphragm plates 27 and 28 which have a lower absorption value are swingingly mounted upon these stands in such manner that they swing about two axes 29 and 30 extending parallel to each other in a plane perpendicular to the central ray. When closed, the diaphragm plates 27 and 28 extend in a plane perpendicular to the central ray 22; they have front surfaces 31 and 32 directed to the field which are shaped as wedges. Due to the provision of springs 35 and 36, the extensions 33 and 34 of the diaphragm plates engage a ring 37 which is axially movable in the diaphragm casing 19. When this ring is shifted, the diaphragm plates 27 and 28 will open to a greater or smaller extent. The ring 37 is provided with several radial pins 38 and 39 which slide in grooves 40 of the diaphragm casing which is parallel to the central ray; the pins 38 and 39 also slide in helical grooves 41 of a cylinder 42 which is mounted in the diaphragm casing and is rotatable about the central ray 22.

In the part of the primary ray diaphragm which is directed toward the X-ray tube there are two diaphragms 43 and 44 with central openings for screening two ray cones of different sizes. When the X-ray examining apparatus is switched off from ray emission to exposure, the diaphragms 43 and 44 are jointly removed from the flow of rays upon actuation of a contact (not shown) by two-armed levers 45 and 46 which are mounted in the diaphragm casing 19 and are connected with traction magnets 47 and 48 operating against the action of springs 49 and 50. However, the diaphragm 43 with the smaller opening can be also removed independently and by itself from the ray flow by the switch 15 (FIG. 1). Then only the diaphragm 44 with the larger opening will remain and the image magnifier is then fully illuminated.

The diaphragm plates 27 and 28 are adjusted by interconnected switch levers 17 (FIG. 1). These levers turn the cylinder 42 by means of a Bowden drive 51 and shift the ring 37 axially by means of the helical grooves 41 provided in the cylinder 42. Then the diaphragm plates 27 and 28 are shifted along with their extensions 33 and 34 engaging the ring 37. Finally, by the use of switch levers 16 (FIG. 1) which are also interconnected and through a Bowden drive 52, the diaphragm disc 21 along with the plates 27 and 28 attached thereto, can be rotated about the central ray 22.

FIG. 3 shows a light screen 53 carried by a remote view apparatus 54 connected with the image magnifying remote view device of the described X-ray examining apparatus. The screen 53 is shown as carrying a visible image. The diaphragms 43 and 44 (FIG. 2) which are provided with openings, screen the ray cone to a round field 55 represented upon the screen. Those parts of the light screen which are outside of this field remain dark. Within this round field 55, screened by one of the openings of the diaphragms 43 and 44, is a field 56 showing the required information which was screened by screen plates 27 and 28 having a lower ab-
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3 absorption value. Due to this lower absorption of the screen plates, the area between the round field 55 and the screened field 56 is darkened to the extent that the darkened light intensity of this section of the screen increases to a substantial extent the representation of details of the screened field 56 by avoiding the overhanging rays, while on the other hand, the outlines of the extremity as well as the complex of instruments moved thereto are still well recognizable.

Thus the primary ray diaphragm of the present invention makes it possible, despite the screening of the actual field 56 containing the required information, to control upon the screen the application of the instruments taking place outside of this field and to follow their movements until they appear upon the actual field 56. At the same time excessive lighting of sections of the screen located to the sides of the actual field is avoided. The specific construction of the front sides of the half-transparent diaphragm plate portions prevents their showing upon the screen. The construction of the half-transparent diaphragm plates as slot diaphragms as well as the fact that they are rotatable around the central ray, facilitate their use in any desired position of the apparatus relatively to the patient, particularly in the case of operations involving extremities. Finally, the adjusting mechanism described above and illustrated in FIG. 2 provides a particularly space-saving and simple mechanical construction of the diaphragm.

In the specification and claims the term "diaphragm" is used to describe an X-ray filter. The term "primary rays" is used to describe X-rays as they emerge from an X-ray tube and before they strike the patient. The term "ray field" is used to describe a cone of X-rays emerging from an X-ray tube or filter. The term "absorption value" is used to describe the extent of absorption of X-rays by a filter. The term "central ray" is used to describe the X-ray extending along the central longitudinal axis of the cone of X-rays.

We claim:

1. In an X-ray examining device emitting primary rays, at least two adjustable X-ray wedge filter plates in the ray field, a casing for attachment to said device, a support disc, means rotatably supporting said disc in said casing perpendicularly to the central ray of the ray field, two parallel axles carried by said support disc and extending perpendicularly to the direction of said central ray, said two X-ray filter plates being pivotally mounted upon said axles and rotatable about said central ray with said support disc, a ring mounted in said casing parallel to said support disc and movable in the direction parallel to that of the central ray, extensions carried by said X-ray filter plates, resilient means pressing said extensions against said ring, radial pins carried by said ring, said casing having grooves extending parallel to said central ray, a cylinder mounted in said casing parallel to said ring and rotatable about said central ray, said cylinder having grooves extending helically around said central ray, said radial pins passing through said helical grooves and engaging the grooves in said casing, whereby said ring is movable in a direction parallel to said central ray to adjust the lateral separation of said filter plates.

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