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DIAPHRAGM APPARATUS FOR X-RAY TUBES

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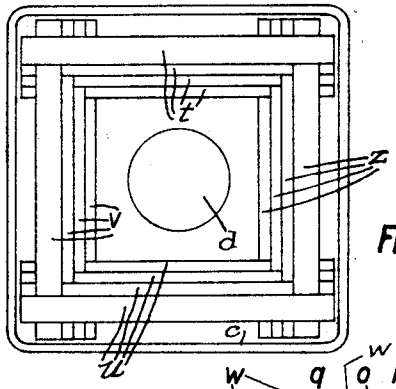

Fig. 2.

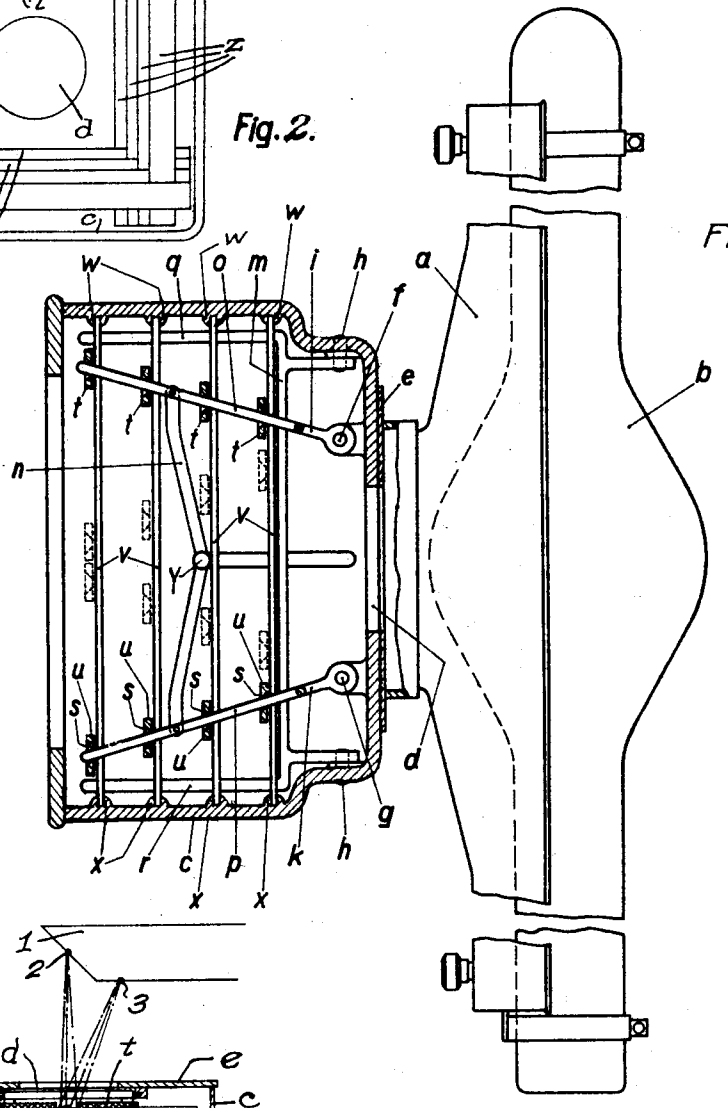

Fig. 1.

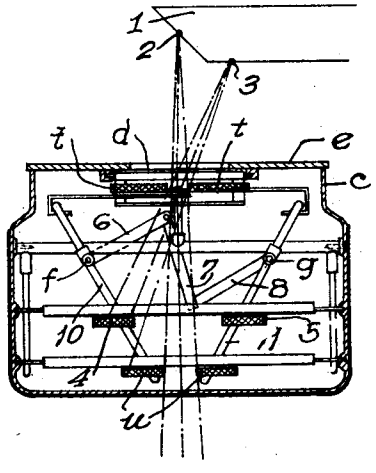

Fig. 3.

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DIAPHRAGM APPARATUS FOR X-RAY TUBES

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This invention relates to improvements in X-ray apparatus and has particular reference to a diaphragm apparatus for X-ray tubes.

In order to limit the pencil of X-rays issuing from the point of emission of an X-ray tube, it has heretofore been known to install, directly on the protective casing of the tube, two diaphragms consisting of a substance which is practically impermeable to X-rays, said diaphragms intersecting and being perpendicular to the principal direction of the X-rays. It has been found that with the diaphragms attached directly to the tube casing at a short distance from the point of emission of the X-rays, the outline of the image of the aperture formed by said diaphragms manifests considerable indistinctness even at a relatively short distance therefrom. Owing to the importance of avoiding an excessive increase in the size of the diaphragm apparatus, as well as the avoidance of unusual electrical effects between the electrode caps of the X-ray tube and the diaphragms, when the latter are open, it has been hitherto impossible to remedy the indistinctness of the image by arranging the diaphragms at a greater distance from said tube.

According to the present invention, the above drawbacks are overcome by the provision of a diaphragm apparatus wherein the adjustable diaphragms of at least one pair are disposed in spaced relation to each other.

The inventive idea involved is capable of receiving a variety of mechanical expressions, some of which, for purposes of illustration, are shown in the accompanying drawing wherein:—

Figure 1 is a vertical section of one form of diaphragm apparatus, showing it attached to the protective casing of an X-ray tube;

Figure 2 is a front elevation of the apparatus with the front wall of the casing therefor removed; and

Figure 3 is a view similar to Figure 1, illustrating another form of the invention.

Referring more particularly to the accompanying drawing, *a* indicates the protective casing of the X-ray tube *b* secured to the latter in the usual manner.

The diaphragm apparatus shown in Figures 1 and 2 comprises a casing *c* of rectangular formation and made of a substance which is practically impermeable to X-rays, said casing being secured directly to the casing *a* and having an inner or rear aperture *d* in the base *e* through which the pencil of X-rays emanates from the tube *b*.

In the interior of the casing *c* adjacent the vertical side walls thereof there are provided on the base *e* two pairs of pivots *f* and *g*, only one pivot of each pair being shown inasmuch as Figure 1 is a sectional view and does not show the second side wall.

A similar pair of pivots *h*, perpendicular to the pivots *f*, *g*, is disposed in the top and bottom of the casing *c* adjacent the vertical side wall shown and a fourth pair of pivots (not shown in Figure 1) similar to the pivots *h* are provided near the vertical side wall of the casing *c* which is opposite the one illustrated.

Mounted on the upper pair of pivots *f* for pivotal movement in a vertical plane is a diaphragm actuating element *i* and a similarly supported actuating element *k* is carried by the lower pair of pivots *g*. The pivots *h*, shown in Figure 1, carry an actuating element *m* which moves in a horizontal plane and a fourth element (not shown) is supported like the element *m* by the other pair of pivots similar to said pivots *h*. All four of the diaphragm actuating elements are of the same construction (see element *m*) and may be described as fork-like members having arms at the ends thereof. Thus the elements *i*, *k*, respectively, have two arms *o* and *p* (one

shown in each instance) and the element m has the arms q and r at its opposite ends; the fourth element, similar to m, being likewise constructed. In order that the two elements i and k may be simultaneously adjusted toward and away from each other, they are connected by at least one pair of links n having a common pivotal point y which may be actuated in any preferred manner. Likewise, the other pair of elements, including m, may be similarly adjusted by links (not shown).

Within the casing c and designed to be actuated by the elements i, k, et cetera, are four sets of diaphragms t, u, v and z, the first two sets being arranged horizontally and the last two vertically. These various sets combine to form a number of groups, each consisting of four diaphragms t, u, v, z and, as best shown in Figure 1, the various groups are spaced apart and are different distances from the X-ray tube. The ends of the different diaphragms are preferably made to slide in guide grooves in the walls of the casing c in planes perpendicular to the direction of the X-rays, only the grooves w, x for the diaphragms v being illustrated for the sake of clearness. The arms p of the actuating element k extend through openings s adjacent the ends of the lower horizontal set of diaphragms u and, similarly, the arms of the other actuating elements of the apparatus pass through openings in the diaphragms with which said elements are associated.

When the apparatus is in its open position the diaphragms are arranged as shown in full lines in Figure 1, the distance between parallel diaphragms of each group increasing from the X-ray tube outwardly. By adjusting the various links n, said diaphragms may be moved in the various guide grooves to the dotted line position of Figure 1, or to any intermediate stage, thereby regulating the size of the aperture through which the pencil of X-rays will pass.

In order to make sure that the relatively narrow adjustable diaphragms that limit the pencil of X-rays do not permit the escape of other X-rays, such as the so-called stem rays, than those that issue from the point of emission of the X-ray tube, the diaphragm apparatus may also be constructed as in Figure 3. In this construction, the arrangement is such that, between the adjustable diaphragms which are arranged at a distance from one another and which serve for limitation of the pencil of X-rays issuing from the point of emission of the X-ray tube, at least one additional adjustable diaphragm is disposed in such a way that it will prevent, in any of its positions, the escape of the X-rays, particularly the stem rays, that do not issue from the point of emission of the X-ray tube. In this connection, the adjustment of this intermediate diaphragm, or of these intermediate diaphragms, as the case may be, is effected in an advantageous manner by means of the adjustment members, such as levers or the like.

Thus, in the diaphragm casing c (Figure 3) having the diaphragm aperture d in its base e which is attached to the X-ray tube (together with the anticathode 1), there is arranged, in addition to the adjustable diaphragms t and u which limit the pencil of X-rays issuing from the point of emission 2, the intermediate pair of diaphragms 4, 5 which serve for prevention of the escape of the X-rays (stem rays) that do not issue from the point of emission 2, but which may be emitted from a point 3 of the anticathode 1. The adjustment of the intermediate diaphragm is expediently effected by the levers 10, 11 which are connected with one another by means of a suitable system of links or levers 6, 7, 8 and which also serve for adjustment of the diaphragms t, u in a manner similar to that described in connection with Figure 2. The levers 10, 11 are constructed as two-armed levers, the points of rotation f, g of which are situated within the space between the diaphragms t, u which serve to limit the pencil of X-rays issuing from the point of emission 2.

The mechanism shown in Figure 3 operates as follows: Upon rotation of one of the levers 10 or 11 about its fixed pivot f or g from the position shown in Fig. 3 in an outward direction, the diaphragms u are moved away from each other so that the lower diaphragm opening is enlarged. The transmission of the movement from one of the levers to the other occurs automatically through the connections 6, 7, 8, wherein the lever 6 is rigidly connected with the lever 10 at the fulcrum. The lever or arm 8 is rigidly connected with the lever 11 at the fulcrum g, so that upon clockwise swinging of the lower end of the lever 10, the lever 6 is similarly moved and through the linkage 7, 8 produces counter-clockwise oscillation of the lever 11. Similar movement of lever 11 produces a corresponding movement of lever 10. When the lower ends of the levers 10 and 11, as viewed in Fig. 3, move outwardly, the upper ends thereof move inwardly. To the upper ends of the levers 10 and 11 are connected hook-like members each of which is connected to the oppositely positioned diaphragm t; thus the lever 10 is connected with the right hand diaphragm t, while the lever 11 is connected with the left hand diaphragm t. Consequently, enlargement of the opening of the (lower) diaphragm u is accompanied by an enlargement of the opening of the (upper) diaphragm t.

The relative sizes of the openings of the upper and lower diaphragms can be adjusted by suitably selecting the ratio of the lengths of the parts of the levers 10, 11, from their fulcra to the lower diaphragm u and to the hook-like members. In similar fashion the

intermediate diaphragms 4, 5, through which the lower parts of the levers 10 and 11 pass can be so arranged and proportioned that they are carried along by the levers 10 and 11 in such a manner that each such diaphragm in every position thereof intercepts those rays which emanate from points on the anticathode other than the point 2.

What is claimed is:

1. A diaphragm mechanism for X-ray tubes, comprising a plurality of spaced diaphragm sets, each composed of a plurality of movable diaphragms consisting of strips of ray impervious material and forming a closed figure, a housing for said diaphragm sets, and operating mechanism connected with the correspondingly positioned diaphragms of said diaphragm sets for adjusting such diaphragms simultaneously.

2. A diaphragm mechanism as set forth in claim 1, wherein each of said diaphragm sets is composed of four movable diaphragms, said operating mechanism comprising four fork-like levers pivoted within said casing adjacent to the walls thereof, linkage connecting oppositely positioned levers to cause them to move in pairs, said levers passing through openings in said corresponding parts of the diaphragm sets, and guiding means for said diaphragm sets, whereby upon oscillation of said levers the diaphragms of the diaphragm sets are caused to move in planes perpendicular to the main direction of the rays.

3. A diaphragm mechanism as set forth in claim 1, including an intermediate diaphragm set arranged between the first-mentioned diaphragm sets and composed of a plurality of adjustable diaphragms positionable outside of the pencil of useful rays and operative to intercept the stem rays.

4. A diaphragm mechanism as set forth in claim 1, wherein each of said diaphragm sets is composed of four movable diaphragms, said operating mechanism comprising levers pivoted between the outermost and innermost diaphragm sets and passing through openings in said corresponding diaphragms of the diaphragm sets to adjust the same on movement of such levers.

5. A diaphragm mechanism as set forth in claim 1, including an intermediate diaphragm set arranged between the first-mentioned diaphragm sets and composed of a plurality of adjustable diaphragms positionable outside of the pencil of useful rays and operative to intercept the stem rays, said operating mechanism being associated also with said intermediate diaphragm set to adjust the same.

6. A diaphragm mechanism as set forth in claim 1, including an intermediate diaphragm set arranged between the first-mentioned diaphragm sets and composed of a plurality of adjustable diaphragms positionable outside of the pencil of useful rays and operative to intercept the stem rays, said operating mechanism being associated also with said intermediate diaphragm set to adjust the same and comprising a plurality of fork-like levers pivoted within said housing adjacent to the walls thereof, pairs of said levers being linked together for conjoint operation.

In testimony whereof, I have affixed my signature.

LEONHARD RAAB.