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X-RAY FILTER

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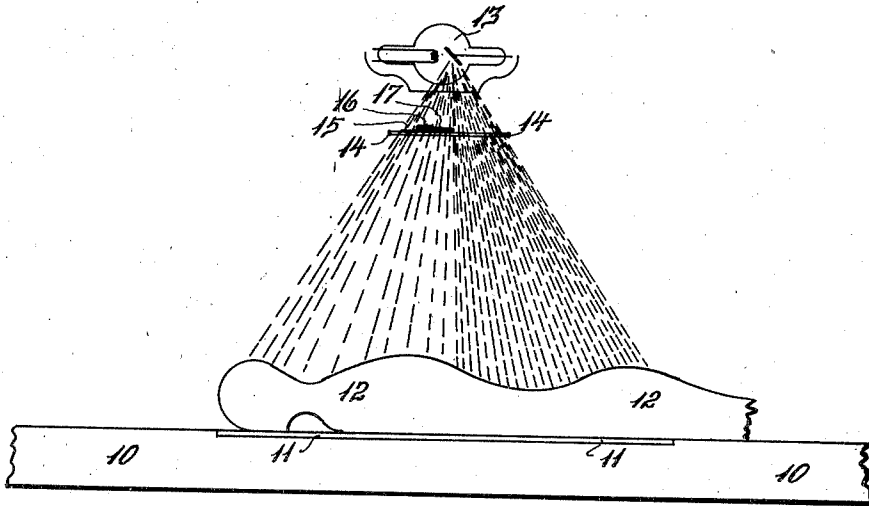


FIG. 1

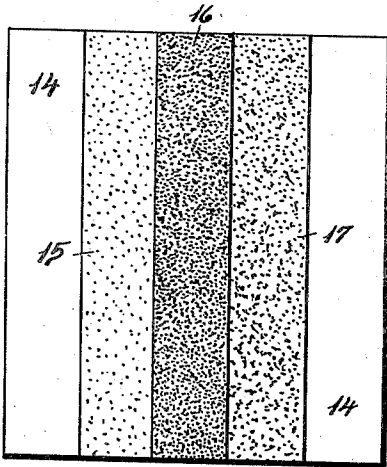


FIG. 2

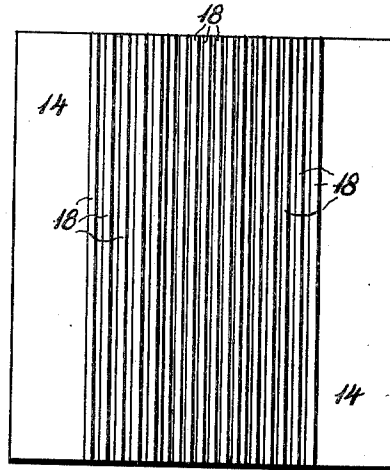


FIG. 4



FIG. 3

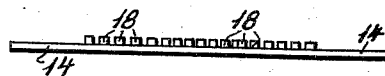


FIG. 5

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X-RAY FILTER

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6 Claims. (Cl. 250—63)

This invention is concerned with the field of radiography, and more particularly with the production of radiographs of the human anatomy, and has as an object to provide improved means for use with radiographic apparatus whereby substantially uniform density and definition may be obtained in radiographs of the human anatomy, irrespective of the variable tissue resistance presented by different portions of the human anatomy to the passage of the rays or emanations whereby the desired radiograph is produced.

A further object of the invention is to provide an improved filter for use with X-ray apparatus in the production of radiographs of the human anatomy.

A further object of the invention is to provide improved means operable to proportion the number or intensity of X-ray emanations to the tissue resistance presented by various portions of a subject being radiographed.

A further object of the invention is to provide an improved construction for X-ray filters.

A further object of the invention is to provide an improved X-ray filter construction which is susceptible of development in a variety of specific embodiments to proportion the X-ray emanations passed therethrough to the resistance of various specific portions of the subject being radiographed.

A further object of the invention is to provide an improved X-ray filter which is simple and inexpensive of manufacture, adaptable through various specific embodiments and arrangements to a variety of specific uses, which is productive in use of radiographs of substantially uniform intensity and definition irrespective of the varying resistance to X-ray penetration presented by the subjects of such radiographs, which is simple and convenient of practical employment, and which is not subject to deterioration through long-continued use.

My invention consists in the construction, arrangement, and combination of elements hereinafter set forth, pointed out in my claims, and illustrated by the accompanying drawing, in which—

Figure 1 is a conventionalized, diagrammatic representation of the elements essential to production of a radiograph of the human spine wherewith the improved filter is operatively associated. Figure 2 is a plan view of one embodiment of the improved filter. Figure 3 is an end elevation of the showing of Figure 2. Figure 4 is a plan view of an alternative embodiment of

the invention. Figure 5 is an end elevation of the showing of Figure 4.

Radiographs are produced by directing the emanations from an X-ray tube or source through the subject for action on and against a suitably sensitized surface, as is common and well-known practice. Obviously, with a uniform emanation of X-rays throughout a uniform period of time against a given sensitized surface, such surface will be affected to a varying degree controlled by the resistance of the subject, or various portions of the subject, to the passage of the X-rays therethrough, the resulting radiograph thus varying undesirably in density and definition. This condition is particularly apparent when efforts are made to obtain radiographs of the human spine or similar relatively large areas of the human anatomy wherein varying resistances to X-ray passage are encountered, it being obvious that the human neck offers less resistance to X-ray than the adjacent thorax and lower skull and jaw portions, while the latter present less resistance than is met with in the abdominal region. The instant invention is concerned with means for so varying the number or intensity of the ray emanations from a given source as to proportion the effective rays passing through the subject to the resistance of the various portions of said subject, to the end that a radiograph of such areas may be distinct, uniform in tone, density, and definition, and hence provide a clearly-readable picture of the adjacent and related portions of the subject in a single graph.

In the drawing, the numeral 10 designates a suitable table or like support arranged to mount and suitably position the suitably sensitized film or plate 11 and to provide a support for the subject 12 in overlying relation with the sensitized medium 11 and in the path of the rays emanating from the target of a suitable X-ray tube 13 positioned in suitably spaced relation with and on the opposite side of the subject 12 from the sensitized medium. The construction and arrangement of the elements just described is strictly conventional and in itself forms no part of the instant invention, and is to be considered as merely typical of specific installations and arrangements of radiographic apparatus wherewith the invention may be advantageously employed.

The improved filter comprises a relatively thin base plate 14 of material non-resistant to the passage of X-rays, said base plate being of any desired or convenient size, specific shape, and specific material having the characteristic above

noted, and a plurality of strips or areas of material resistant to the passage of X-rays fixed to and suitably disposed on one side of the base plate 14. According to the showing of Figures 2 and 3, the ray-resistant areas may be formed as juxtaposed strips or bands, in this instance three in number, as indicated at 15, 16, and 17, the band 15 being relatively the less resistant, the band 16 being relatively the most resistant, and the band 17 having a resistance intermediate that of the bands 15 and 16. The showing of Figures 2 and 3 represents a resistant band construction resulting from the use of ray-resistant material, such as lead, bismuth, barium, or the like, in granular or comminuted form built up in layers of suitable thickness through the use of suitable binders, the relative thickness of the bands so constructed and the density of granules or material used determining the resistance of a given band to the passage of X-rays therethrough. The material employed for the resistant bands is such as will obstruct and preclude penetration by X-rays, hence a solid band of such material would serve to actually prevent the passage of any rays through that portion of the base plate 14 covered by such a band, but the granular character of the material permits the formation of relatively minute passages through the band, the number of said passages in a given band naturally decreasing with an increase in the density of granules and as the thickness of the band is increased, through which passages a portion of the rays impinging upon a given resistant band may pass, the resistant bands hence functioning to obstruct a portion of all the rays impinging thereon, regardless of the ray characteristics, and permitting the passage of a portion of all such rays, in proportion to the relative thickness and density and consequent number of passages presented by the given band. The band 16, being relatively the thickest, will pass the minimum number of rays through the filter assembly illustrated in Figures 2 and 3, and hence such band is disposed on the base plate 14 in the path of the rays directed against the neck portion of the subject which presents the least resistance to X-ray penetration, when the filter assembly is operatively disposed between the tube 13 and the subject 12, as indicated in Figure 1. Since the thorax presents more resistance to X-ray passage than does the neck portion, but less than other portions of the subject's anatomy when the spine is to be radiographed, the band 17, being intermediate the bands 15 and 16 in resistant properties, is disposed adjacent the band 16 and in position to intercept the rays impinging upon the thorax, while the band 15 is disposed on the opposite side of the band 16 in position to intercept the rays directed to and through the skull base and jaw portions of the subject, the rays directed to pass through the abdominal portion of the subject encountering no resistant band and hence being permitted to act with full intensity. While the embodiment shown and described is illustrated as comprising resistant bands of equal width disposed in juxtaposed, parallel relation transversely of the base plate 14, it is to be understood that such specific representation is but typical of a variety of arrangements of resistant bands adapted to function as may be desirable in obtaining radiographs of various subjects, or of various portions of a given subject, and that the resistant bands may be variously disposed and arranged on the base plate 14 in such combinations of relatively thicker and rela-

tively thinner band elements as may be best adapted to a specific use.

The alternative embodiment of the invention illustrated in Figures 4 and 5 is functionally identical with that illustrated in Figures 2 and 3 and hereabove described, and is representative of various structural arrangements wherethrough the principles of the invention may be made practically effective. In the alternative construction, the ray-resistant bands are grouped on the base plate 14 for the same purpose hereabove set forth, but such bands are composed of relatively quite narrow strips of material impervious to the passage of X-rays spaced apart on a given area of the base plate to permit the passage of only the desired proportion of rays impinging on such area. By varying the number of the strips covering a given base plate area, and hence by varying the spacing between said strips, the number of rays permitted to pass through a given area may be controlled and regulated in the same manner as is possible through variation in the thickness and density of the ray-resistant layers 15, 16, and 17, formed of granular material. Figures 4 and 5 show an arrangement wherein strips 18 are relatively widely spaced on an area of the base plate 14 corresponding to that covered by the band 15, other strips 18 are somewhat more closely spaced to cover an area corresponding to that covered by the band 17, and still further strips 18 are relatively more closely spaced to cover an area corresponding to that covered by the band 16 and in the same relative position. The size and spacing of the strips 18 is very much exaggerated in the drawing to permit of better illustration, and it is to be understood that, in practice, such strips would be relatively very narrow and very closely spaced. It is of course obvious that the strips 18, or equivalent elements, could be disposed in covering relation with areas of the base plate 14 in such specific patterns and arrangements as might be effective to develop ray-resistant bands of the desired relative permeability, and that perforated sheets or strips of ray-impervious material might be substituted for the granular layers and spaced parallel strips illustrated, without in any way altering or departing from the spirit and principle of the invention.

Since many changes in the specific form, arrangement, and construction of the elements shown and described may be had without departing from the principle of the invention, I wish to be understood as being limited solely by the scope of the appended claims, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention—

1. The combination with radiographic apparatus of means for proportioning the effective number of image-forming rays to the relative resistance to ray passage of portions of the subject being radiographed, said means comprising a ray-permeable plate fixed intermediate the ray source and the subject, and ray-limiting areas built up of ray-impervious material so disposed on said plate in the path of the emanations impinging upon the subject portions of relatively lesser ray resistance as to permit the passage through such areas of a number of rays proportioned to the relative ray resistance of the corresponding subject portion.

2. The combination with radiographic apparatus of means for proportioning the effective number of image-forming rays to the relative ray resistance of portions of the subject being radio-

graphed, said means comprising a ray-permeable plate fixed intermediate the subject and the source of ray emanations, and ray-limiting areas built up of ray-impervious material so disposed on said plate in the path of the emanations impinging upon the subject portions of relative lesser ray resistance as to limit the number of rays passing through such areas to a quantity proportioned to the relative ray resistance of the subject portion covered thereby.

3. In radiographic apparatus, means for proportioning the effective number of image-forming ray emanations to the relative ray resistance of varying portions of a subject being radiographed, said means comprising a supporting plate of ray-permeable material, and areas of lesser ray permeability built up on said plate in the path of the ray emanations impinging upon subject portions of relatively lesser ray resistance by covering desired zones of said plate with a layer of ray-impervious material in granular form.

4. In radiographic apparatus, means for proportioning the effective number of image-forming ray emanations to the relative ray resistance of varying portions of a subject being radiographed, said means comprising a supporting plate of ray-permeable material, and areas of lesser ray permeability built up on said plate in the path of the ray emanations impinging upon subject portions of relatively lesser ray resistance by covering desired zones of said plate with a layer of ray-impervious material in granular

form, said areas varying in thickness and consequent limitation of ray passage therethrough inversely as the resistance to ray passage of the subject portions covered thereby.

5. In radiographic apparatus, means for proportioning the effective number of image-forming ray emanations to the relative ray resistance of varying portions of a subject being radiographed, said means comprising a supporting plate of ray-permeable material, and areas of lesser ray permeability built up on said plate in the path of the ray emanations impinging upon subject portions of relatively lesser ray resistance by covering desired zones of said plate with closely-spaced, narrow strips of ray-impervious material.

6. In radiographic apparatus, means for proportioning the effective number of image-forming ray emanations to the relative ray resistance of varying portions of a subject being radiographed, said means comprising a supporting plate of ray-permeable material, and areas of lesser ray permeability built up on said plate in the path of the ray emanations impinging upon subject portions of relatively lesser ray resistance by covering desired zones of said plate with closely-spaced, narrow strips of ray-impervious material, the width and spacing of the strips in said areas and the consequent limitation thereby of ray passage therethrough being nonuniform and varying inversely as the resistance to ray passage of subject portions covered thereby.

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