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2,580,360

X-RAY SHIELD

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FIG-1

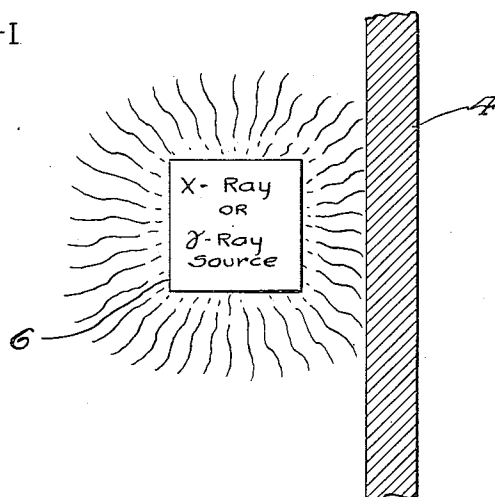
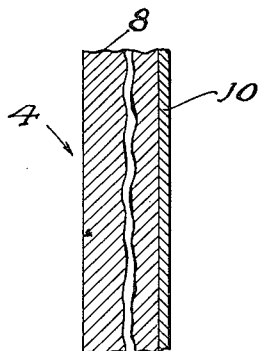


FIG-2



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X-RAY SHIELD

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9 Claims. (Cl. 250—108)

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My invention relates to a shield that serves as an efficient protection against X-rays, gamma rays and other penetrating radiations.

It is generally known that the heavier elements are more satisfactory as shields from X-rays, gamma rays and other penetrating radiations, than are the lighter elements, since the heavier elements can be used in thinner sections. Lead of suitable thickness has been used most widely for shielding operators and patients from the undesirable effects of such penetrating radiations. For high radiation intensities of penetrating rays, such as obtained from a cyclotron target, radium, or nuclear fission, appreciable thicknesses of lead are required, for example, of the order of several inches, making the shields very expensive, heavy and difficult to handle. Although uranium is a heavy metal, its use as a shield from X-rays, gamma rays and other penetrating radiations has been avoided in the past, because of an undesirable characteristic of uranium, the metal being itself an emitter of alpha and beta rays.

An object of my invention is to provide a shield that is highly efficient in preventing the transmission of X-rays, gamma rays and other penetrating radiations.

A more specific object of my invention is to nullify the above-mentioned undesirable characteristic of uranium, namely, its own emission of alpha and beta rays, thus making uranium suitable as a shield for protection against X-rays, gamma rays and other penetrating radiations.

These and other objects will become more apparent from the following description.

The effectiveness of a metallic shield for protection against X-rays, or gamma rays of energy greater than 2 m. e. v., that is, its absorption coefficient, is proportional to

$$\frac{Z^2 P}{A}$$

where Z is the atomic number of the element, P the density of the element and A the isotopic mass number of the element. The particular power of the factor Z is further dependent upon the particular X-ray energy and the absorption region. It can be determined mathematically that for two million electron volt radiations, corresponding to about 0.006 Angstrom, uranium is superior to lead as an absorber of X-rays. More specifically, for two million electron volt (2 m. e. v.) radiations, an equivalent shield of uranium is 20 per cent thinner than a tungsten shield, and 45 per cent less thick than a shield of lead for the same absorption. Uranium is even more superior for radia-

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tions more penetrating, that is, greater than energies of 2 m. e. v. For frequencies somewhat less than the equivalent of 2 m. e. v. radiation, uranium retains an advantage over lead in shielding but to a lesser degree in view of the application of the expression

$$\frac{ZP}{A}$$

for energies in the neighborhood of 1 m. e. v., that is, the expression involves the first power of Z, instead of Z² as in the case for energies of 2 m. e. v. and above.

Inasmuch as uranium is itself an emitter of alpha and beta rays, its use as a shield for X-rays and the like has not hitherto been considered.

I have found, however, that the above-mentioned disadvantage can be overcome by coating the uranium metal with a heavy metal pigment, such as, for example, red lead. This pigment coating effectively absorbs both the alpha and beta radiations from the uranium. Thus, the combination of a surface coating of lead with a thick uranium absorber possesses outstanding advantages in the control of penetrating radiations such as X-rays and gamma rays as well as alpha and beta rays.

It will be seen, therefore, that I have provided an efficient shield of uranium for protection against the effects of penetrating radiations such as X-rays and gamma rays, such shield being more efficient than lead for radiation frequencies corresponding, for example, to two million electron volts (2 m. e. v.) energy, or more. Furthermore, I have eliminated the inherent disadvantage of uranium used as a shield material, because of its own emission of alpha and beta rays, by coating the uranium with a material that absorbs these self-generated radiations, such as, for example, lead.

For an illustration of an embodiment of the invention in accordance with the patent laws, reference is made to the attached drawing in which:

Figure 1 is a schematic plan view of a shield wall made in accordance with the invention together with a radiation source; and

Figure 2 is a fragmentary cross-sectional view of the shield wall of Figure 1.

As illustrated in Figure 1, the shield wall 4 is employed to absorb and shield the radiations emanating from an X-ray or gamma ray source 6. As shown in Figure 2, the wall 4 consists of a sheet 8 of uranium, on the outer surface of which is a relatively thin layer 10 of another heavy material, such as lead in the form of a red-lead pigment.

It should be noted that the above-described embodiment of the use of uranium as a shield is merely illustrative and not limiting, insofar as my invention is concerned. Other modification will be readily suggested to those skilled in the art after having had the benefit of the teachings of my invention. For example, instead of using uranium metal as a shield, an alloy, or perhaps a compound, containing a large percentage of uranium, may be used instead. Furthermore, instead of painting the uranium surface with a heavy metal pigment, such as red lead, a thin sheet of lead or other suitable absorbing material such as bismuth, may be used as a surface sheet either adjacent to or separated from the uranium, for the purpose of absorbing alpha and beta rays. In short, any material having a relatively high absorption coefficient for alpha and beta rays may be used. For these reasons, my invention should not be limited except insofar as set forth in the following claims.

I claim:

1. A shield for substantially preventing the transmission of X-rays, gamma rays and other penetrating radiations, comprising a uranium metal base and a coating of heavy metal on said base, said coating consisting of non-radioactive elements of a density at least equal to that of red lead.

2. A shield for substantially preventing the transmission of X-rays, gamma rays and other penetrating radiations, comprising a uranium containing base and a coating of heavy metal pigment on said base, said coating consisting of non-radioactive elements of a density at least equal to that of red lead.

3. A shield for substantially preventing the transmission of X-rays, gamma rays and other penetrating radiations comprising a sheet of uranium together with a surface sheet of lead.

4. A shield for substantially preventing the transmission of X-rays, gamma rays and other penetrating radiations comprising a sheet of uranium and a sheet of material having an absorption coefficient for alpha and beta rays at least equal to that of red lead, said material consisting of non-radioactive elements.

5. A shield for substantially preventing the transmission of X-rays, gamma rays and other penetrating radiations, comprising a sheet of uranium and a red lead pigment coated on the surface of said sheet.

6. In combination with a source for producing penetrating radiations, such as X-rays and gamma rays, a protective shield for absorbing said rays and preventing transmission thereof through said shield comprising a sheet of uranium together with a sheet of material having a relatively high absorption coefficient for alpha and beta rays emitted by said uranium sheet said material consisting of non-radioactive elements of a density at least equal to that of red lead.

7. In combination with a source for producing penetrating radiations, such as X-rays and gamma rays, a protective shield for absorbing said rays and preventing transmission thereof through said shield, comprising a sheet of uranium together with a sheet of heavy non-radioactive metal having an absorption coefficient for alpha and beta rays at least equal to that of red lead, said last-named sheet being furthestmost from said source.

8. In combination with a source for producing penetrating radiations, such as X-rays, and gamma rays, a protective shield for absorbing said rays and preventing transmission thereof through said shield, comprising a sheet of uranium and a coating of heavy non-radioactive metal pigment of a density at least equal to that of red lead on the surface of said uranium sheet to absorb alpha and beta rays emitted by said uranium sheet.

9. In combination with a source for producing penetrating radiations, such as X-rays and gamma rays, a protective shield for absorbing said rays and preventing transmission thereof through said shield comprising a sheet of uranium and a coating of red lead on the surface of said uranium sheet to absorb alpha and beta rays emitted by said uranium sheet.

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