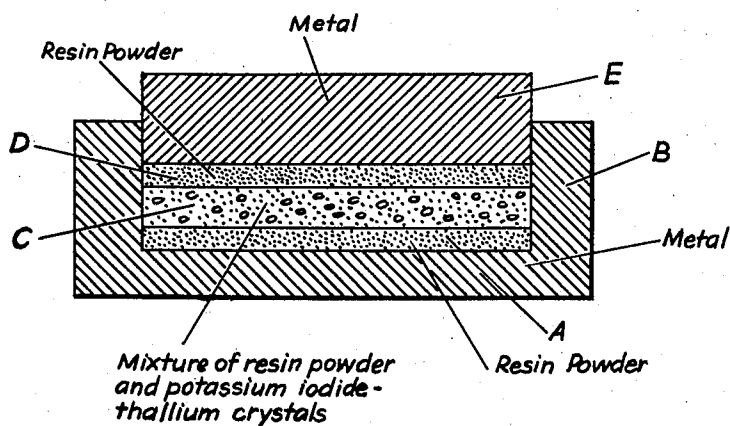


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H. T. DYBVIG
MANUFACTURE OF THALLIUM ACTIVATED ALKALI
METAL IODIDE INTENSIFIER SCREENS
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INVENTOR

H. Talman Dybvig

BY Henry W. Conklin

Edward P. Gilheaney

ATTORNEYS

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**MANUFACTURE OF THALLIUM ACTIVATED
ALKALI METAL IODIDE INTENSIFIER
SCREENS**

Henry Talman Dybvig, Binghamton, N.Y., assignor to
General Aniline & Film Corporation, New York, N.Y.,
a corporation of Delaware

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4 Claims. (Cl. 250—80)

The present invention pertains to durable, substantially water impervious X- and gamma-ray intensifying screens, and more particularly to such screens composed of a substantially water repellent resin transparent to the radiation fluoresced by alkali metal iodides and having crystals of thallium activated alkali metal iodides imbedded therein, and to the method of preparing such screens.

Thallium activated alkali metal iodide crystals particularly of potassium iodide and sodium iodide are among the best known X- and gamma-ray intensifiers. This is attributable to the possession by such crystals of the following characteristics:

- (1) High mass absorption;
- (2) Relatively efficient conversion of the X- and gamma-ray energy to actinic light energy; and
- (3) High transparency to actinic light enabling passage of the light from the crystal.

These attributes would normally recommend such crystals for use in apparatus employed for detection of ionizing radiation, such as monitoring badges, scintillating counters and the like. It is unfortunate, however, that such crystals possess the decided drawback of being hygroscopic in nature. Thus, even after a few hours in a normal atmosphere, the surface of the crystals becomes occluded with water, resulting in a serious reduction in the light output of the intensifier. This property, despite the other favorable characteristics of the crystals, has very materially limited their application as X- and gamma-ray intensifiers.

It has now been discovered that it is possible to effectively use such crystals in all X- and gamma-ray intensifier applications without manifestation of the above difficulty by imbedding the crystals in a protective sheet or slab of a substantially, water repellent resin which is transparent to the radiation fluoresced by potassium or sodium iodide, to wit, radiation having a wavelength ranging from the visible light region to about 300 mμ in the ultraviolet region. Such sheets or slabs, containing thallium activated potassium or sodium iodide crystals, and the production of such sheets and slabs constitute the purposes and objects of the present invention.

The sheets in which the thallium activated potassium or sodium iodide crystals are incorporated are resins which must be substantially water repellent, transparent to the KI/Tl or NaI/Tl fluorescence radiation as aforesaid and capable of formation from their monomeric powders by pressure molding at a temperature below the melting point of the selected iodide, and preferably below 500° F. Suitable resins for my purpose are polyacrylates, i.e., polyacrylic acid, polymethacrylic acid; polymers of the esters of acrylic and methacrylic acid such as polymethylacrylate, polyethylacrylate, polymethylmethacrylate, polyethylmethacrylate and the like; polystyrene and similar polymers.

The sheets and screens of the KI/Tl or NaI/Tl crystals and the appropriate resin are prepared by mixing

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the crystals and the powdered monomer, charging the mixture into an electrically heated pressure mold and forming the powdered material under heat and pressure. For best results it is recommended that a layer of the powdered monomer be arranged above and below the mixture of the crystals and monomer. By the latter procedure, a structure is obtained in which the layer of crystals and the resin are sandwiched between two layers of the resin. The outer resin layers in this structure operate to give greater moisture protection and added strength.

The ratio of powdered monomer to the crystals may vary, depending upon the monomer selected, the thickness of sheet desired and the like. I have found that, for practical purposes, the quantity of the crystals may vary from about 3 to 10 parts by weight per 1 part by weight of the resin monomer. With these ratios it is customary to form the sheets or screens in a thickness from 1/4" to 1/8" although it is to be understood that such thicknesses are not critical.

The following examples, when read with the accompanying self-explanatory drawing depicting in cross section a conventional mold with the molding materials located therein, will serve to further illustrate the invention.

Example I

Thallium activated potassium iodide, such as that sold by Harshaw Chemical Company, 1945 East 97th Street, Cleveland, Ohio, is powdered and mixed with powdered methylmethacrylate monomer in the ratio of 10 parts of the former to 1 part of the latter. A thin layer of powdered methylmethacrylate indicated by reference letter A and in the accompanying drawing is charged into the mold indicated by reference letter B. Over this is charged the mixture of crystals and methylmethacrylate indicated as C. A further layer of monomer, indicated as D, is then applied over the mixture. The mold is closed through plate E and heated by conventional electrical means (not shown) to a temperature of about 270° F. at a pressure of 1000 pounds per square inch. The temperature is then allowed to rise to 300° F. and the pressure increased to 5000 pounds per square inch. These conditions are maintained for three minutes, whereupon the mold is allowed to cool to room temperature with slow reduction of the pressure. The pressure is then released to complete the molding operation.

There is produced in this manner a sandwich comprising two outer layers of polymethylmethacrylate with an intermediate layer of KI/Tl crystals imbedded in the polymethylmethacrylate. In an effective screen so made the outer resin layers may, for example, contain 40 milligrams per square centimeter of polymethylmethacrylate, whereas the intermediate layer may contain 820 milligrams per square centimeter of KI/Tl and 160 milligrams per square centimeter of polymethylmethacrylate. The overall thickness of the sheet is approximately one-quarter inch.

Example II

The procedure was the same as in Example I, excepting that the methylmethacrylate monomer was replaced by powdered styrene and molding was effected at a temperature ranging from about 300 to 375° F. and a pressure of 2000 to 4000 pounds per square inch.

Example III

The procedure is the same as in Example I, excepting that NaI/Tl crystals are used in lieu of KI/Tl crystals.

It is evident that the sheets and screens produced by my procedure contain the active crystals imbedded in a permanent resin binder which permits passage of light

3 radiation which is emitted by the crystals. Despite the fact that the crystals are bonded as stated, they, nevertheless, have the same gamma intensification as the original unbonded crystals. This is surprising, particularly when it is considered that the crystals are enveloped in an inactive medium and that the envelopment procedure necessitates the application of high temperatures and pressures to the crystals.

Various modifications of the invention will occur to persons skilled in the art. It is thus evident that, in lieu of the resins of the examples, other resins may be utilized in the formation of the sheets or screens. It is equally evident that by varying the quantity of the materials used per unit area of the mold employed, screens or sheets of varying thickness may be produced. I, therefore, do not intend to be limited in the patent granted except as necessitated by the appended claims.

I claim:

1. An X- and gamma-ray intensifier screen substantially impervious to water consisting of a laminated

4 structure, one layer of which is composed of thallium activated alkali metal iodide crystals dispersed throughout and bonded in a substantially, water repellent resin transparent to the radiation fluoresced by the alkali metal iodide, said layer being sandwiched between two outer layers of such a resin.

2. The article as defined in claim 1, wherein the alkali metal iodide is potassium iodide.

3. The article as defined in claim 1, wherein the resin is a polyacrylate.

4. The article as defined in claim 1, wherein the resin is polymethylmethacrylate.

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