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(54) X-RAY SCREENING MATERIALS

(71) We, WARDRAY PRODUCTS (CLERKENWELL) LIMITED a British Company, of 15-19 Bakers Row, London EC1R 3DT do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to X-ray screening materials and especially to materials in sheet form for use in the production of, for example, protective clothing, such as aprons and lower back shields, curtains, mobile screens and suspended shields.

The normal X-ray absorber used in such materials is lead or a lead compound and sheet materials are known which comprise lead filled natural rubber or lead filled poly vinyl chloride (P.V.C.). The effectiveness of such sheet material in X-ray screening is determined by two factors, namely, the amount of lead or lead compound contained in the filled sheet material and the thickness of the filled sheet material. Because the rubber or P.V.C. acts as a binder for the lead filler it is not possible to increase the amount of filler above a certain limit, which for metallic lead is of the order of 90% by weight of the total composition. To achieve X-ray shielding effects greater than those that can be achieved by increasing the amount of filler alone thicker sheets must be used.

Conventional practice in the manufacture of for example protective garments comprises taking a sheet of the filled sheet material of thickness appropriate to the X-ray shielding effect required cutting it to the size and shape required and enclosing it in an outer envelope of suitable material, for example plasticised P.V.C. sheet. It has also been proposed to use a laminate material comprising a filled sheet material of appropriate thickness to which is bonded, on either side, a protective covering of, for example,

P.V.C. sheet. In this method of operation the need for a separate outer envelope is obviated.

This current practice of increasing the X-ray shielding efficiency by increasing the thickness of the filled sheet material used results in materials which are of insufficient flexibility to be convenient in use. Moreover, in the case of garments, because of their lack of flexibility they are extremely uncomfortable to wear.

This invention is based on the observation that X-ray screening materials in sheet form having greater flexibility than the hitherto known X-ray screening materials of the same X-ray absorber content can be produced if, instead of using a single sheet of filled sheet material of increased thickness, one uses a plurality of sheets of lesser thickness together forming a laminar material of the desired thickness and one bonds the individual sheets together at their edges and, optionally, at other spaced apart points away from the edges thereby allowing one sheet to move relative to another.

According to the invention an X-ray screening material comprises an array of at least two superposed sheets prepared from a composition comprising a natural or synthetic polymeric material, optionally in combination with a plasticiser therefore, and, as a filler, a material serving as an X-ray absorber, the two outer sheets having on their outer surfaces decorative and/or protective surface covering, for example a layer of unfilled rubber or plastics material, and the array of superposed sheets being bonded together round its edges, there being un-bonded areas between the sheets in portions of the sheets away from the edges.

The polymeric material, which serves as a binder for the X-ray absorber, may be a natural polymer, such as for example natural rubber, or synthetic polymer, for example, PVC. The X-ray absorbing material

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may be, for example, metallic lead, a lead compound, for example lead oxide, barium or a barium compound or even a non-metallic X-ray absorber. Preferably however

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metallic lead is used. The outer surfaces of the array of superposed sheets have laminated thereto a decorative and/or protective surface covering, which may for example comprise unfilled PVC or other plastics material. The other surface of the outer layers may be uncoated and this is particularly advantageous because such coating materials have no X-ray screening property and only serve undesirably to increase the thickness of the array thereby decreasing its flexibility. In certain cases however it may be advantageous to provide a coating of a lubricious plastics material between the layers to assist relative movement therebetween. The array of superposed sheets will normally comprise only two sheets but it is possible to include further sheets of filled polymer composition when it is desired to increase the X-ray screening efficiency further. Such additional sheets will not normally have a surface covering.

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The filled plastics material, when the polymer is PVC, will normally require the presence of a plasticiser for the PVC. The addition of such plasticisers is conventional in the art.

The lead content of a filled PVC composition will normally be of the order of 90% and by using a composition it is possible to produce a sheet .015 inch thick having an X-ray shielding efficiency equivalent to a sheet of lead 0.13mm thick. In order to achieve greater X-ray shielding efficiency the thickness of the filled composition layers can be increased but, by so doing, the flexibility of the overall material is reduced and it is preferred to introduce additional layers to achieve the desired thickness.

The surface coating layer on the outer surfaces of the array is normally from 0.05 to 0.07 inch thick although the thickness of the coating layer may be reduced below this level providing that a continuous coating can still be achieved.

Bonding of the edges of the array may, for example, be effected by welding or adhesion of one layer to another or by stitching and especially by binding the edges with a piece of binding material turned around and stitched over the edges.

The X-ray screening material may be made up into an X-ray protective garment having a fastening two straps, each attached to a respective part of the garment to be fastened by a disengageable fastening means and each having on its outer end portion a fastener. The fastener may be a metal or plastic fastener or "Velcro" (Registered Trade Mark). Such a garment is the subject

of Patent Application No. 8004518.

An embodiment of the invention will now be described, with reference to the drawings accompanying the provisional specification in which:-

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Figure 1 is a rear view of an X-ray protective apron embodying the invention; and

Figure 2 is a diagrammatic section through the material used to make up the apron shown in *Figure 1*.

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Figure 2 shows two sheets 11 of lead filled composition P.V.C., each of which is bonded to a sheet 12 of P.V.C. material. The sheets 11 are placed together with their uncovered surfaces in contact and the X-ray apron shown in *Figure 1* is made up from the two ply material thus formed. The 2-ply material is bound at the edges of the apron by leather (not shown). As shown, the material has an X-ray shielding effect equivalent to a sheet of lead 0.13 mm thick.

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Referring now to *Figure 1*, the apron, made up from the material shown in *Figure 2* is fastened by means of two belts 14 and 15 attached respectively to the rear portion of the apron. The free ends of the belts 14 and 15 have portions bearing VELCRO (Registered Trade Mark) fastening material, enabling the belts to be secured together across the front of the wearer of the apron. Alternatively metal or plastics fasteners would be provided. The other ends of the belts 14 and 15 are detachably secured to the sides of the back of the apron by metal D-rings 16 that are secured within a loop of leather or stout plastics material fastened by press studs and secured to the back of the apron.

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In a modified form, the apron may have a releasable fastening at one or both of the shoulder portions thereof holding together two separable portions of the or each shoulder of the apron. Preferably, in order that the apron may be as comfortable as possible to wear the fastening is fastened at the front of the apron forward of the shoulder. The front of the apron preferably stops short of the shoulder while the shoulder strap or the back portion extends right over the shoulder and overlaps the front, so that the weight of the apron is suspended on the shoulders by the more flexible part of the apron rather than by a more rigid reinforced joint portion.

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WHAT WE CLAIM IS:-

1. An X-ray screening material comprising an array of at least two superposed sheets prepared from a composition comprising a natural or synthetic polymeric material, optionally in combination with a plasticiser therefor, and, as a filler, a material serving as an X-ray absorber, the two outer sheets having bonded to their outer surfaces a decorative and/or protective sur-

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5 face covering, and the array of superposed sheets being bonded together round its edges, there being unbonded areas between the various layers in portions of the sheets away from the edges.

2. A material as claimed in claim 1, wherein the surface covering material is a layer of flexible unfilled rubber or plastics material.

10 3. A material as claimed in claim 1 or 2, wherein the polymeric material, which serves as a binder for the X-ray absorber, is P.V.C.

4. A material as claimed in any one of claims 1 to 3, wherein the X-ray absorbing material is metallic lead.

15 5. A material as claimed in any one of claims 1 to 4, wherein the inside surface of the outer layer is uncoated.

20 6. A material as claimed in any one of claims 1 to 5, wherein the array comprises only two X-ray absorbing sheets.

25 7. A material as claimed in any one of claims 1 to 5, wherein the array includes one or more additional X-ray absorbing sheets sandwiched between two outer sheets.

30 8. A material as claimed in any one of claims 1 to 7, wherein bonding of the edges of the array is effected by welding or adhesion of one sheet to another or by stitching.

35 9. A material as claimed in any one of claims 1 to 7, wherein bonding of the edges of the array is effected by binding the edges with a piece of binding material turned round and stitched over the edges.

40 10. A material as claimed in claim 1, substantially as described herein with reference to Figure 2 of the drawing accompanying the provisional specification.

11. A protective garment made from an X-ray screening material as claimed in any of claims 1 to 10.

45 12. A protective garment as claimed in claim 11 substantially as described herein.

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FIG. 1

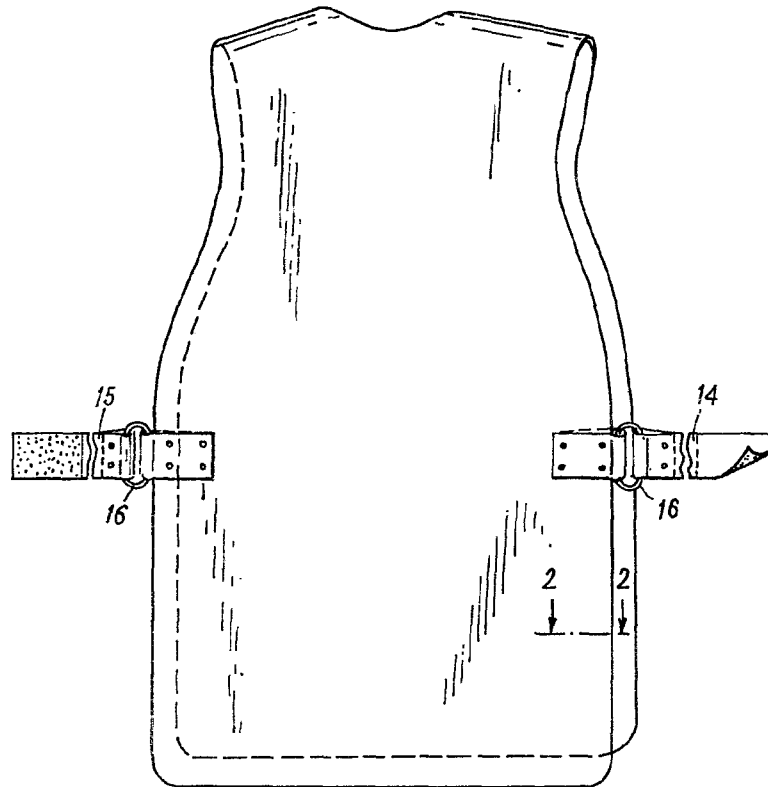


FIG. 2

