FTU24 XR 2,970,218

Jan. 31, 1961 F. A. C. SHAW 2,970,218

BRICK FOR RADIATION SHIELDS

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Fig. 1.

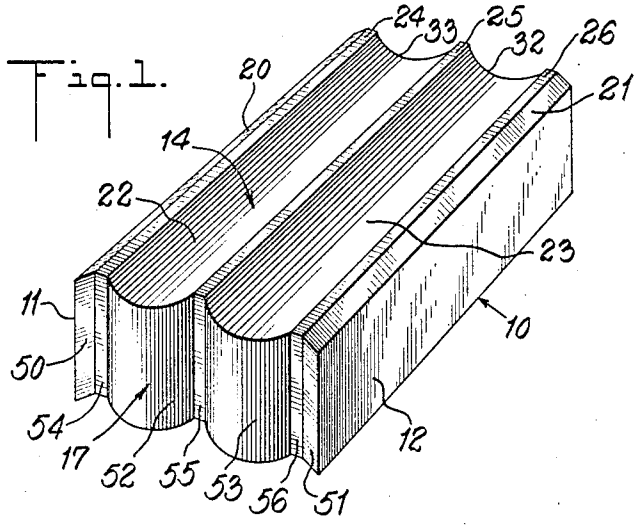


Fig. 2.

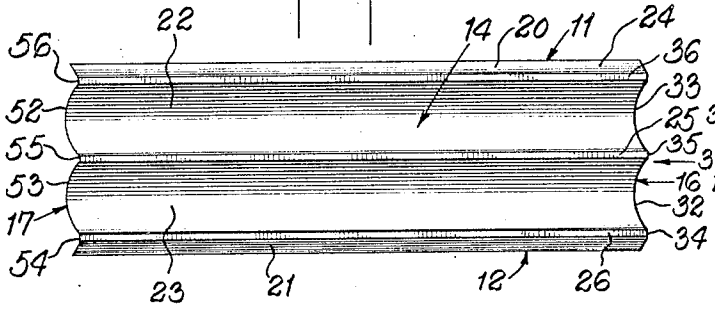
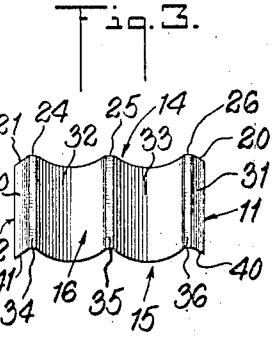


Fig. 3.



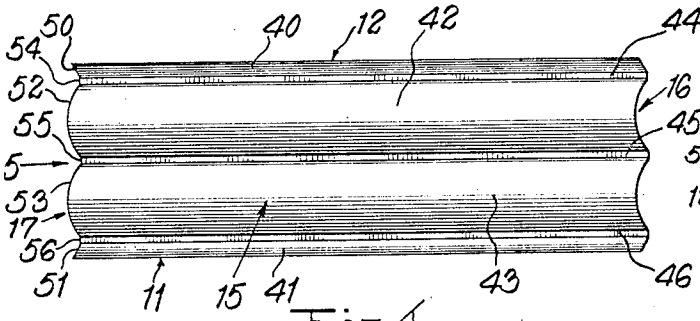


Fig. 4.

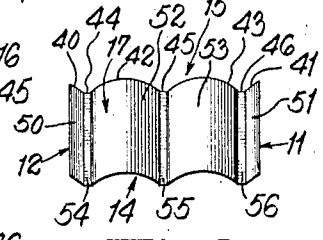


Fig. 5.

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Fig. 6.

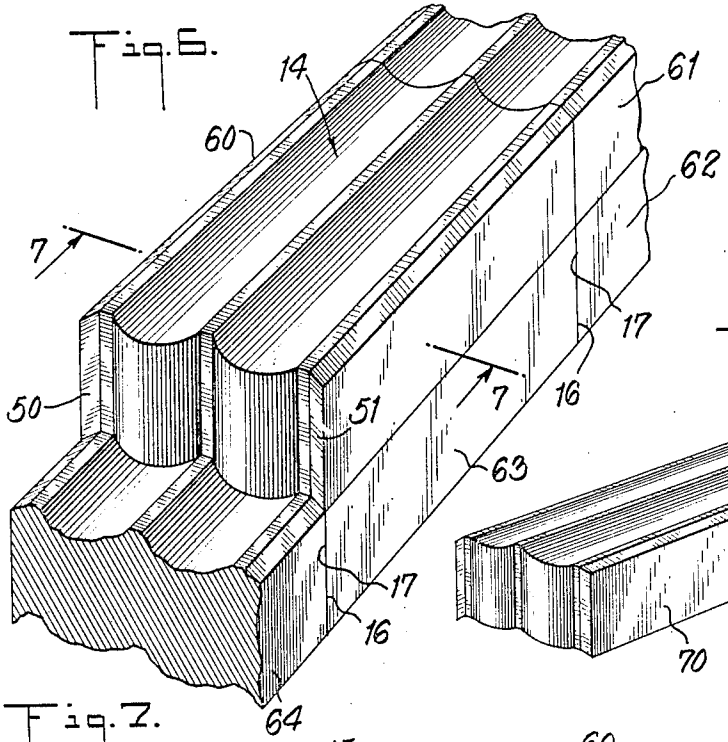
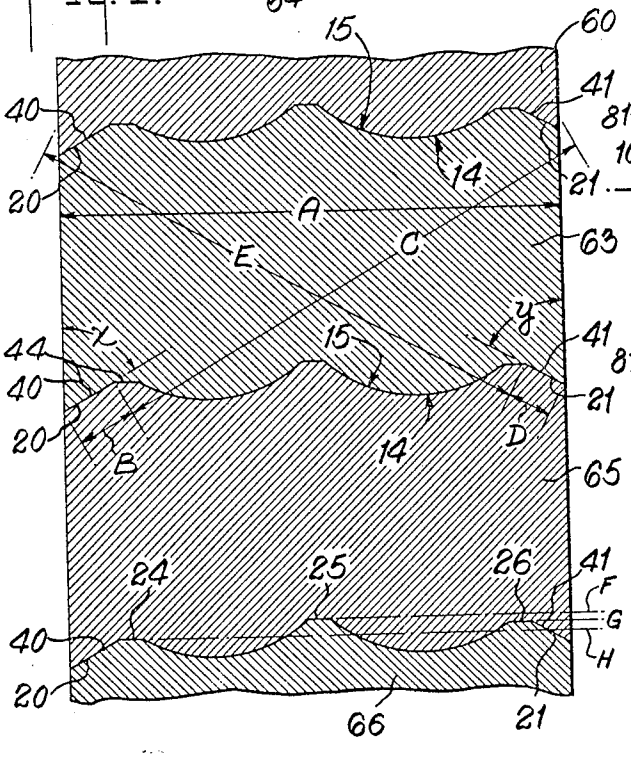


Fig. 8.

Fig. 7.



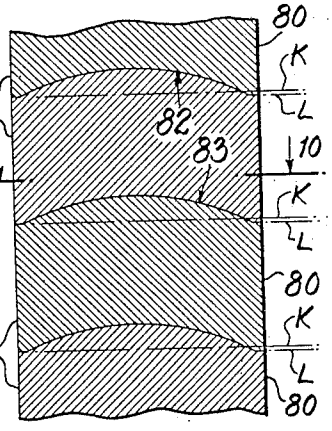


Fig. 9.

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Fig. 10.

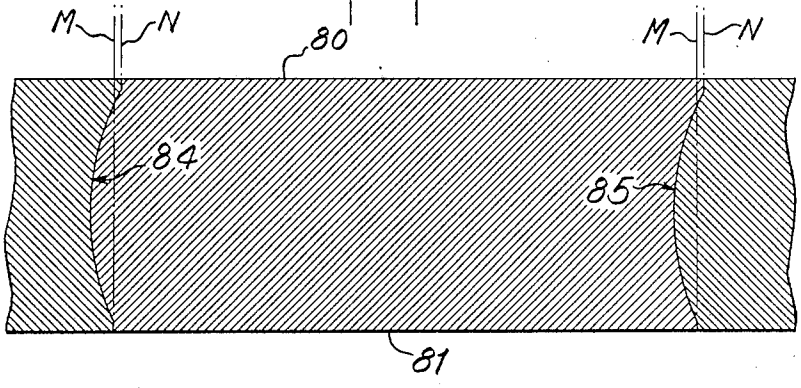
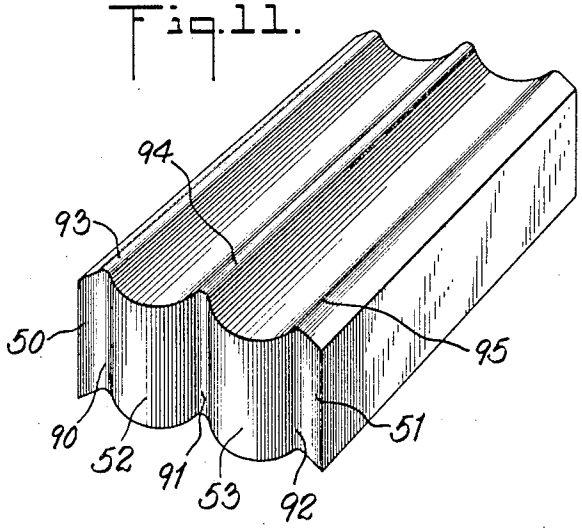


Fig. 11.



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BRICK FOR RADIATION SHIELDS

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5 Claims. (Cl. 250—108)

This invention relates to a brick useful in the construction of radiation shields. More particularly, it relates to a brick for constructing an interlocked shield against nuclear radiation, and especially to a lead brick for shielding against gamma rays.

In many instances where it is necessary to provide a radiation shield, it is desirable or necessary, due, for example, to the size of the shield required, to fabricate the shield from a number of units or bricks rather than to fabricate a one piece monolithic shield. The shield, whether it be in one piece or fabricated from a plurality of pieces, should provide a uniform barrier to the radiation and should not contain gaps through which rays or radiating particles can pass. Where the shield is not a one piece shield, the units or bricks comprised in the shield should be fabricated in such manner as to provide interlocking joints with adjacent bricks in the shield. Moreover, such joints should provide a radiation barrier of the desired magnitude.

One of the advantages of the invention is that it provides an interlocking brick for the construction of a radiation shield. Another advantage is that a brick is provided for the construction of a shield in which the joints between the bricks in the shield present an adequate and substantially uniform radiation barrier to a source of radiation. Another advantage of the brick of the invention is that it permits the fabrication of a shield in which the radiation barrier presented by the joints between the bricks is equal in shielding value to that supplied by the thickness of the solid material of which the brick is composed. Moreover, these advantages are obtained with lower amounts of shielding material than would otherwise be possible in the absence of the invention and this is another important advantage of the invention. Another important advantage is that the invention provides a brick for the construction of a shield, without the use of additional amounts of material, in which shield the joints between the bricks present a radiation barrier which is at least equal in shielding value to that of a one piece shield composed of the same material as the brick. This and other advantages will become apparent from the following description of the invention.

Broadly, the invention comprehends a brick having a mating face comprising a curved or fluted portion and two straight unaligned shoulder portions. Improved results are obtained where the lack of alignment is provided by disposing the straight shoulder portions at an angle to the face, and preferably also at an angle to each other. For best results, the depth of the angularly disposed straight shoulder portions is such that a line extended from the straight portion through the brick or an adjacent brick encounters a mass of brick material which is at least equal to the thickness of the brick. In the most preferred brick, the straight shoulder portions are disposed diagonally or substantially diagonally in the brick.

The brick of the invention may be fabricated of any suitable shielding material. Preferably, the bricks are

fabricated of a high density metal such as lead, tungsten, tantalum, etc.—especially where the volume of shielding installation must be kept at a minimum. The invention, however, is most advantageously used in connection with bricks fabricated of a dense soft metal which, most preferably, is lead.

One or more, and preferably a plurality of, fluted portions are employed in the face. The fluted portion or portions of the face may have any curved configuration. Preferably, and especially where the brick is fabricated of lead, the face contains two fluted portions which are arcs of a circle or circles. Preferably also, for ease of fabrication of the brick and assembly of the shields, the flutes are arcs of circles having the same radius. In general, the smaller the radius of the circular flutes, the shorter will be the length of the cord which is subtended at any given gap tolerance between mating brick faces in the shield. Preferably, therefore, the radius of the circular flute or flutes is as small as possible consistent with the width of the face and the desired depth of the shoulder portions.

The invention is further illustrated in the accompanying drawings. It should be understood, however, that the drawings are given for purposes of illustration and the invention in its broader aspects is not limited thereto.

In the drawings:

Fig. 1 is a perspective view of a lead brick illustrating the preferred embodiment of the invention;

Fig. 2 is a top plan view of the brick of Fig. 1;

Fig. 3 is a side view of the brick taken in the direction of arrow 3 of Fig. 2;

Fig. 4 is a bottom view of the brick of Fig. 1;

Fig. 5 is a side view of the brick taken in the direction of arrow 5 of Fig. 4;

Fig. 6 is a view of a typical wall assembly, in perspective and partly in section, employing the brick of Fig. 1;

Fig. 7 is a vertical section through a typical wall section taken along line 7—7 of Fig. 6;

Fig. 8 is a perspective view of a brick further illustrating the invention;

Fig. 9 is a vertical sectional view similar to Fig. 7 of a shield employing a modified form of brick;

Fig. 10 is a sectional view taken on line 10—10 of Fig. 9; and

Fig. 11 is a view similar to that of Fig. 1 showing a modified form of brick.

Referring now to Figs. 1 through 7, there is shown a brick indicated generally by the numeral **10**, having a pair of flat side faces **11** and **12**, and two sets of opposing faces, i.e. top and bottom faces **14** and **15** and end faces **16** and **17** respectively, adapted to mate with faces on adjacent bricks in a shield. Each of the faces **14** through **17** comprises two straight shoulder portions and two fluted portions; one face in each set, i.e. faces **14** and **16**, being a female face and the other face in each set, i.e. faces **15** and **17**, being a male face.

Thus, as shown in Figs. 1 and 2, female face **14** has two angularly disposed shoulder portions **20** and **21** and two fluted portions **22** and **23**. Straight flat lands **24**, **25** and **26** may also be disposed as shown between the shoulders and the flutes, and between the flutes. Female face **16** is likewise provided with shoulder portions **30** and **31**, and fluted portions **32** and **33** and may also possess lands **34**, **35** and **36**—see Fig. 3. Male face **15** is also provided with shoulders **40** and **41** and with fluted portions **42** and **43** and may also posses lands **44**, **45** and **46**—see Fig. 4. Likewise, male face **17** has shoulders **50** and **51** and flutes **52** and **53** and may also have flat lands **54**, **55** and **56**—see Figs. 1 and 5.

Fluted portions **42** and **43** in male face **15** and fluted portions **52** and **53** in male face **17** are convex while

fluted portions 22 and 23 in female face 14 and fluted portions 32 and 33 in female face 16 are concave. As shown, all of these fluted portions form arcs of circles all of which circles have the same radius. The straight shoulders in the male faces 15 and 17 slope toward their adjacent fluted portions in these faces while the shoulders on the female faces slope away from the adjacent flutes on these faces.

The planes of the surface of flat shoulders 20 and 21 on female face 14 are disposed at an angle with respect to each other and to the vertical longitudinal plane of the brick; and this is also true of the planes of flat shoulders 40 and 41 in male surface 15. The planes containing the flat surface of shoulders 30 and 31 in female surface 16 are likewise disposed at an angle to each other and to the vertical transverse plane of the brick and this is also true of the flat shoulders 50 and 51 of male surface 17. For ease in fabrication of the brick and assembling of a shield the plane containing shoulder 20 and that containing shoulder 40 are parallel and this is also true respectively of shoulders 21 and 41, shoulders 30 and 50, and shoulders 31 and 51. Also for ease in fabricating the brick and assembling a shield, the acute angles formed between the vertical longitudinal plane of the brick and the planes containing the flat surface of shoulders 20, 21, 40 and 41 are equal, as is illustrated by angles x and y in Fig. 7. Likewise, the acute angles formed between the vertical transverse plane of the brick and shoulders 30, 31, 50 and 51 are equal and may also be equal to the acute angles formed by the shoulders in faces 14 and 15 with respect to the vertical longitudinal plane of the brick. The surface of the lands 24, 25 and 26 in face 14 are disposed in different but parallel planes as illustrated by planes F, G and H in Fig. 7; and this is also the disposition of lands 34, 35 and 36 in face 16, lands 44, 45 and 46 in face 15, and lands 54, 55 and 56 in face 17. If desired, the lands in the various faces may also be angularly disposed with the same or different acute angle as that of the shoulders in the face.

A typical interlocked wall shield employing the brick of Fig. 1 is illustrated in Figs. 6 and 7. The wall is assembled by abutting and superimposing the brick as illustrated by brick 60 through 66 in these figures. Thus, as illustrated in Fig. 6, the shoulders and flutes of female face 16 of brick 64 is mated and interlocked with the shoulders and flutes of abutting male face 17 of brick 63 and the female face 16 of the latter brick is similarly mated with the male face 17 of brick 62 and so on. Brick 60, as illustrated in Fig. 7, is superimposed on brick 63 with the shoulders and flutes of male face 15 of brick 60 mating and interlocking with female face 14 of subjacent brick 63 and the male face 15 of the latter brick is similarly mated with the female face 14 of brick 65 and so on.

While the joints formed by the mating faces of the bricks in the wall assembly shown in Figs. 6 and 7 are tight in the ordinary sense, it will be appreciated that there may be a considerable space between mating faces as compared to a ray such as a gamma ray. Nevertheless, streaming of the rays through the joints between the brick in the wall is prevented as is illustrated in Fig. 7. Inasmuch as rays such as gamma rays move in straight lines, a ray from a point or line source to the left of the wall in Fig. 7 entering the crack between shoulders 20 and 40 of bricks 63 and 65 respectively, will travel unimpeded in a path parallel to these shoulders until it reaches land 44 of brick 63 after which it will enter the lead of the brick in continuing its straight-line travel. Assuming that the rays will be absorbed in straight-line travel through a lead barrier of thickness A, a ray entering the crack between these shoulders will be absorbed by the brick when the length of line C is not less than the width A of the brick. This also applies to a ray entering the shield from the left of Fig. 7 and traveling in a straight line which lies between but parallel to shoulders 21 and 41. Such a ray will also be absorbed where the dimensions D and E of the path of the ray through the brick are such that E is at least equal to A.

As will be seen from Fig. 7, the length of line C depends, for any given angle x, upon the depth B of shoulders 20 and 40. The depth B of the angularly disposed shoulder is therefore such that C is at least equal to A. When, as illustrated in Fig. 7, the line C is to lie wholly in brick 63 and be equal to the thickness A of the brick, the shoulder 40 preferably lies in or substantially in the diagonal of the transverse plane of the brick inasmuch as such a disposition permits the use of shoulders in which the depth B is greatest.

It will also be seen from Fig. 7 that as angle x decreases from the diagonal the line C will, to an increasing extent, extend into adjacent brick 60 but the shoulder portions will in turn become more sharp and less rugged in construction. On the other hand, as the angle x becomes larger than that of the diagonal angle, the interlocking provided by the shoulders decreases inasmuch as the depth B of the shoulders is decreased to provide a line of line C which is at least equal to A. For this reason also the plane of the shoulders 20, 21, 40 and 41 lie in or are parallel to the diagonal of the transverse plane of the brick. It will be understood that the depth of angularly disposed shoulders 30 and 31 in face 16 of the bricks and that of shoulders 50 and 51 on face 17 of the bricks, is likewise such that, for each of these shoulders, a line lying in the horizontal longitudinal plane of the brick and extending into the brick from the shoulder is at least equal to the width A of the bricks. When, as is preferable, the length of the brick is greater than its width, the depth of the shoulders in faces 16 and 17 may be the same as that as the shoulders in faces 14 and 15 while still permitting the extension of the line from each of shoulders on faces 16 and 17 into the brick to be at least equal to A even though the acute angle between these latter shoulders and the vertical transverse plane of the brick is different from or is the same as angle x. Preferably, however, the angular disposition of the shoulders in faces 16 and 17 with respect to the vertical longitudinal plane is equal or substantially equal angle x. The radiation shielding thus provided throughout the length of the wall assembly shown in Figs. 6 and 7 is substantially the same as that of a one piece monolithic wall composed of the same material and having the thickness A of the bricks.

The brick shown in Fig. 8 is useful in corner construction of a radiation shield. The brick is the same as that of Fig. 1 except the side 70 contains a mating portion having the configuration of faces 16 or 17 of the brick of Fig. 1. As shown, this portion has the configuration of male face 17 with shoulders 50 and 51, flutes 52 and 53, and lands 54, 55 and 56. In assembling a shield with a corner, the female face 16 of a brick 10 of Fig. 1 is placed so as to abut the male portion in side 70 of the brick of Fig. 8 after which the corner is extended in the same manner described in connection with Figs. 6 and 7.

A shield employing a modified brick is shown in Figs. 9 and 10. As will be seen from these figures, each of the bricks has a pair of flat faces 80 and 81 and two sets of opposing faces, i.e. top and bottom faces 82 and 83 and end faces 84 and 85. Each of the faces 82 through 85 comprise two straight flat shoulder portions disposed in different but parallel planes and a curved or fluted portion; faces 83 and 84 being female faces with their fluted portions concaved and faces 82 and 85 being male faces with their fluted portions convexed. The different but parallel planes in which the shoulders of the top and bottom faces lie are illustrated by planes K and L in Fig. 9. The different but parallel planes of the shoulder portions of the end faces are illustrated by planes M and N in Fig. 10.

Fig. 11 illustrates another modified brick which is the

same as that of Fig. 1 except that the lands are curved as is illustrated by the curved lands 90 through 95. In a shield assembled with the bricks of Fig. 11, the joints between the bricks present to a ray such as a gamma ray a radiation barrier which is equal in shielding value to that of a one piece shield of the same thickness and composed of the same material.

The bricks of the invention may be fabricated in any suitable manner. Preferably, they are fabricated by extrusion and milling. Thus, for example, in a lead brick of the type shown in Fig. 1, the sides 11, 12, 14 and 15 may be formed by extruding lead through a suitable die. The extruded shape may then be cut to the appropriate length and the side faces 16 and 17 may be cut into each brick in any suitable device such as, for example, a milling machine.

What is claimed is:

1. A brick for a radiation shield, said brick having a male mating face on one side and a male mating face on one end thereof, each of said faces comprising a fluted portion and two straight, oppositely disposed and unaligned shoulder edge portions, and a corresponding reverse female mating face on the side and end opposite to said first mentioned side and end of said brick.

2. A brick for a radiation shield, said brick having a male mating face on one side and a male mating face on one end thereof, each of said faces comprising a fluted portion and two straight, oppositely disposed shoulder edge portions, the planes of said shoulder portions in each of said faces being disposed at an angle to each other, and a corresponding reverse female mating face on the opposite side and end of said brick.

3. A brick according to claim 2 in which a line on each shoulder edge portion of each male face which lies on the surface of such shoulder portion perpendicular to the outer edge thereof encounters when extended into the brick a mass of brick material which is at least equal to the thickness of the brick.

4. A brick according to claim 3 in which the brick is composed of lead, and in which each of said male mating faces contains a plurality of fluted portions each of which is an arc of a circle.

5. A brick for a radiation shield, said brick having a male mating face on one side and a male mating face on one end thereof, each of said faces comprising a fluted portion and a plurality of straight portions, each of said straight portions lying in different planes, and corresponding reverse female mating faces on the opposite side and end of said brick.

References Cited in the file of this patent

UNITED STATES PATENTS

468,838	Steiger	Feb. 16, 1892
1,710,833	Mirabella	Apr. 30, 1929
1,758,903	Willets	May 13, 1930
1,780,107	Barry	Oct. 28, 1930
1,815,921	Lapof	July 28, 1931

FOREIGN PATENTS

136,318	Australia	Feb. 10, 1950