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(54) **SHELTER**

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Description

[0001] This invention relates to shelters, and in particular to shelters for hazardous environments, giving protection against blasts and small arms fire.

[0002] There are many places in the world where a rapidly erected shelter, proof against rifle or machine gun fire, and against nearby bomb blasts or shell explosions, is a very desirable refuge. However, they need to be constructed in a hurry in remote places possibly only accessible by helicopter. So shipping in the entire construction is not a realistic option.

[0003] In US 3,886,751 there is described a wall structure formed from a plurality of bags which may be filled with an aggregate such as concrete, although there is no teaching of a shelter, as such.

[0004] In US 5,611,178 there is disclosed an underground shelter comprising two substantially identical rigid panels which may be assembled together into a tunnel configuration over and around which earth and/or sandbags may be placed to increase the effectiveness of the shelter, although there is no teaching of how to make the shelter self supporting other than by leaving the rigid panels in place.

[0005] There is therefore a need for a shelter whose bulk can mostly be supplied from local materials and where just a skeleton structure needs to be brought in to the point of erection, to be "fleshed out" on the ground.

[0006] According to the invention there is provided a shelter comprising an arched lining forming at least a temporary support and an external elongate jacket of bags extending generally horizontally and filled with a filling material, the bags being closed apart from inlets through which the filling material is injected CHARACTERISED IN THAT the bags are compartmentalised and are assembled with the compartments of each bag progressively spaced from the lining.

[0007] Preferably, fine particulate material is used. This could be sand, or possibly earth, although sand may be mixed with cement. However aggregate and concrete in preset slurry form can be pumped to fill bags, and it should be understood that the invention encompasses the use of such coarser materials. Fibres, or small pieces of cloth, might also be added to the mix.

[0008] Once the lining is erected, empty bags will be placed to encase it, and then at least some of the innermost compartments, starting at the lowermost bags and working up towards the crown of the arch, will be filled with filling material. Then the adjacent compartments are filled, and so on until the outermost ones are filled and the shelter is complete. The filling of one range of compartments may start before the next inner one has been completed, although that is not preferred, and certainly it must not overtake the filling of the inner compartments in the approach to the crown of the arch.

[0009] The arch will generally be circular or elliptical, and the bags will preferably be shaped so that they resemble, in cross-section of the shelter, stones around the curve of a masonry arch. In other words they will be wedge-shaped. Preferably, there will be means for positively linking adjacent bags together. In one form these may be rods extending lengthwise of the shelter passing through overlapping eyes on adjacent bags, rather like a hinge pin.

[0010] With the bags all full, they are self-sustaining and the lining may be removed. It can then serve for the construction of another shelter and so on.

[0011] The material of the bags is a matter of choice, and while it is not required of the bags that they be liftable when filled with filling material, it will be preferred to have a strong, reinforced sheet material that could sustain the weight of the contents if lifted. The optimum material available at present is probably "Kevlar" ™, which has been established as being bullet proof, at least to a certain extent.

[0012] Since the bags will be brought to the site empty, they will preferably be made as long as the shelter itself, so that assembly time is reduced to a minimum.

[0013] The filling material will preferably be sand, which is often locally available. But circumstances may dictate the use of earth.

[0014] The sand may be mixed with cement so that the jacket will solidify. Of course, there is no necessity to have all the compartments filled with the same material, and one could have the inner ones solid, with a mixture of sand and cement, and the outer ones just filled with sand.

[0015] The lining may be provided by various means. For example, it could be pre-curved rigid sheet material such as corrugated iron, so that it would resemble a Nissen hut. Alternatively, there could be discrete arches making a ribbed framework along the length of the shelter. These could be left in place or removed once the bags are filled. Alternatively, conventional centering could be employed which would have to be dismantled to make the shelter usable.

[0016] According to another aspect of the invention there is provided a method of assembling a shelter, wherein the lining is erected, the bags are arranged over it and interconnected, and the compartments are progressively filled from the innermost compartments of the lowest bags to the or each outer compartment at the crown of the arch, no compartment being filled until the next one or ones circumferentially lower and radially inner have been filled.

[0017] According to yet another aspect of the invention, there is provided a method of assembling a shelter, wherein the lining is erected, the lowermost bags are positioned and filled from the innermost compartment outwards, the next lowermost bags are positioned and similarly filled, and so on to the crown of the arch.

[0018] In each method of construction bags are filled in a progressive manner with a filling material such as sand or a settable material such as concrete, each bag being placed in conjunction with a filled bag before being filled itself. When the bags are filled, they assist in pre-

venting mutual movement of the bags in at least one direction in the general plane of those faces.

[0019] According to a further aspect of the present invention there is provided a shelter including a barrier comprising courses of bags filled with filling material, the bags of at least one course being wider than the bags of the course below so that at least one side of the barrier has a corbelled out

[0020] In one preferred form the wider bags are divided by longitudinal webs into side-by-side compartments. These will be filled sequentially, the central ones, or those over the existing structure, being filled first to provide stability and a counterweight to the compartments that hang out beyond that existing structure.

[0021] Such barriers can be constructed at the ends of the arched structures outlined above, to complete an all round shelter. But they could be quite independent.

[0022] For a better understanding of the invention, some embodiments will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a bag of trapezoidal cross-section,
Figure 2 shows the bags of Figure 1, divided into three compartments,
Figure 3 is a diagrammatic cross-section of a shelter showing steps in its construction,
Figure 4 is a detail of part of the shelter, in end view,
Figure 5 is a view in the direction A of figure 4,
Figure 6 shows various arch structures to form the basis of the shelter,
Figure 7 shows details of anchoring the shelter to the ground, and
Figure 8 shows an end view of a bag, for forming an arch as shown in Figure 10,
Figure 9 shows another end view of a bag suitable for an arched structure shown in Figure 10,
Figure 10 shows an arched structure,
Figure 11 shows a bag having interlocking portions,
Figure 12 shows a bag having corrugated sides,
Figure 13 shows end views of various wall barriers which can be used in conjunction with the shelter.

[0023] The bags can be described as being of simple form, such as shown in Figure 1 of the accompanying drawing. This is a perspective view of part of a bag 1 of trapezoidal cross-section suitable to form a voussoir, with tubular pockets 2a on the longitudinal edges to receive a rod (not shown) by which adjacent bags are interconnected. Typically the bag is divided into three compartments by internal webs 3, as shown in Figure 2, which is an end view of the bag, pockets 2a omitted. An arched structure such as shown in Figure 3 could be built by such bags filled in a progressive manner.

[0024] The shelter is constructed by filling bags 1 laid over an arched lining 2. In Figure 3, the bags are all similar and are divided into three compartments by internal webs 3. In end view, the bags are slightly wedge-shaped so that they resemble stones following the curve of a masonry arch, and the webs 3 follow the curve of the arch so that there is an inner compartment 4, a middle compartment 5, and an outer compartment 6 in each bag. Although shown in Figure 3 as expanded almost to their eventual shape, when empty they will mostly collapse against the lining 2.

[0025] The inner compartments 4 are filled first, starting from the lowermost bags 1 at the base of the arch. These are filled sequentially towards the crown of the arch until there is a complete, initial jacket of granular material around the lining. Then the middle compartments 5 are filled in the same way starting at the bottom and progressing to the crown. Finally, the outer compartments 6 are filled in a similar fashion.

[0026] As mentioned previously, the filling material is preferably sand, and it may be hardened by adding cement, but not necessarily in every layer.

[0027] Although not shaped as shown in Figure 3, Figure 4 shows two of the lowermost bags, and how they are linked together. The lowermost bag 1 has inner and outer sets of loops 7 of material on its upper side, and the next bag 1 has similar loops 8 on its underside which align with the loops 7 when the bags are correctly positioned. Rods, wire or rope 9 can then be inserted like a hinge pin through both sets of loops, firmly locking the bags together. The other bags are similarly interconnected.

[0028] At the end of each compartment 4, 5 and 6 there is an inlet 10 through which the granular material can be pumped. Dry sand will flow quite easily and each compartment can be filled completely to form a substantially solid barrier.

[0029] To fill a bag a hose could be inserted and led to the far end of the bag, and as it delivered material it would slowly be withdrawn. But this is not the only way, and it may be appropriate to have several entry points along each bag so that the filling is done in batches.

[0030] Figure 6 shows some possible linings. A simple one in Figure 6(a) is curved sheet metal 11, and an alternative in Figure 6(b) is a set of metal framework arches 12 which can be arranged as a ribbed structure, the ribs being close enough to locate and support the bags laid over them. Once the bags are all filled these linings can either be removed or allowed to remain in place. In Figure 6(c) wooden centering 13 locates and supports the bags during construction, and this must be dismantled once the bags are filled and self-supporting.

[0031] Figure 7 shows how the base of the lining may be located. The ground may be dug away so that it is set down into a shallow trench whose walls will resist lateral expansion, as in Figure 7(a).

[0032] Alternatively, ground anchorages 14 may be buried to prevent that lateral expansion, as in Figure 7 (b). Another solution is to link the lowermost bags 1 by straps 15 or a sheet which will extend across the floor of the shelter, as in Figure 7(c).

[0033] There is also a different way of coupling adjacent bags, avoiding the need for the pockets and rods. Examples are shown in Figures 8 and 9 which are end views of bags 1a and 1b suitable for an arched structure as shown in Figure 10. They are still divided by internal webs 3, but each compartment 4, 5 and 6 is offset from the next one circumferentially of the arch to give complementary stepped sides. That is, when similar bags are fitted around an arch the facing sides of adjacent bags interlock in tongue and groove manner.

[0034] In Figure 8 the inner compartment 4 is narrower than the middle one 5, which in turn is narrower than the outer one 6, to take account of the curve of the arch. The square steps of the sides means that perhaps there will not be an exact fit between adjacent bags, but it will be good enough for most purposes. If a better fit is required, especially with arches of small radius, then the bags 1,6 could be formed as in Figure 9 where the sides of the inner and outer compartments 4,6 conform to the wedge shape of Figures 1 and 2. The sides of the middle compartment 5 could also be inclined, but it is considered less important that they should be.

[0035] By constructing bags that will interlock when filled, more ambitious shapes than arches may be constructed, particularly using concrete or other hard-setting but previously pumpable material. Although temporary supports may be required, they will generally not need to be so elaborate as those required for normal poured concrete structures, and with quick-setting cement used in the mix they need only be in position for perhaps half an hour until the concrete is hard and the bag fixed. Even with a substantial overhang it will be safe to remove temporary supports for use elsewhere, by virtue of the mechanical interlock between bags. Shuttering is not required: its function is taken by the bags themselves, which remain in place after the filling material has set.

[0036] The interlocking steps need not match the internal compartmentalising, as indicated by Figure 11, which is an end view of another bag 1c, and the tongues and grooves could be dovetailed or otherwise shaped to give an even more positive link between bags. On the other hand, a somewhat less positive link might be all that was necessary, such as the corrugated sides of the bags 1d shown in end view in Figure 12. In this example, to constrain the sides into the desired shape, the webs 3 that define the compartments are skew, but there is no real disadvantage in that.

[0037] This leaves the ends of the shelter to protect, which may be done by conventional sandbag walls. But like any wall constructed without bonding, these will be no wider at the top than at the bottom, and if they are built to any appreciable height they will generally taper in at the top for stability. But the narrower the top, the more easily it is dislodged.

[0038] By using compartmented and/or different sized bags, this conventional shape can be reversed, with the upper bags being corbelled out beyond the lower ones. The extra weight at the top takes more blast energy to disturb and the lower bags are more firmly compressed and solid.

[0039] Examples are shown in Figure 13. In Figure 13 (a) the lower part of a barrier has two courses of bags 16, each divided longitudinally and vertically by a web 17 into two compartments. These are surmounted by two courses of bags 18 and 19 each divided by webs 20 and 21 into three side-by-side longitudinal compartments. The bags 18 and 19 are recessed underneath so that the bags 18 will sit symmetrically like a saddle over the upper course of the bags 16 and the somewhat wider bag 19 will sit similarly over the bags 18.

[0040] Once the bags 16 are in place and filled, the bags 18 are positioned and their central compartments filled. This gives sufficient counterweight for the outer compartments to be filled safely. Then the bags 19 are placed and filled in the same manner.

[0041] Figure 13(b) shows an alternative, with three courses of two-compartment bags 16 and a top course of overhanging three-compartment bags 22. In Figure 13(c), a corbelled wall is constructed by using bags of different widths, the narrowest bags 23 being at the bottom and the wall expanding via bags 24 and 25 to the top course of widest bags 26. The corbelling may be on one side only, to face the threatened blast, the other side being vertical.

[0042] Although the means by which bags are interconnected, i.e. by using abutting surfaces and by the use of ribs and loops are mentioned separately, it is envisaged that a combination of such means can be used to provide a particularly stable structure.

Claims

1. A shelter comprising an arched lining (2) forming at least a temporary support and an external elongate jacket of bags (1) extending generally horizontally and filled with a filling material, the bags (1) being closed apart from inlets (10) through which the filling material is injected **CHARACTERISED IN THAT** the bags are compartmentalised and are assembled with the compartments (4,5,6) of each bag progressively spaced from the lining.

2. A shelter according to claim 2, wherein the lining is a ribbed framework (12).

3. A shelter according to claim 2, wherein the lining is a rigid sheet material (11).

4. A shelter according to any preceding claim wherein at least some of the filling material is a particulate material that remains un-solidified within the bags (1).

5. A shelter according to any preceding claim, wherein

at least some of the filling material is a combination of substances that solidify within the bags (1).

6. A shelter according to any preceding claim, wherein means are provided for positively interconnecting adjacent bags (1).

7. A shelter according to claim 6, wherein the interconnecting means are elongate elements (9) passed through loops (7,8) or eyes provided externally of the bags (1).

8. A shelter according to claims 1 to 6, wherein adjacent abutting faces of the bags (1) are formed so that adjacent bags mutually key together.

9. A shelter according to claim 8, wherein each compartment (4,5,6) of each bag is partially offset from the adjacent compartment circumferentially of the arch, thereby making each keying face a mixture of ribs and grooves.

10. A method of assembling a shelter as claimed in claim 6 or 7, wherein the lining (2) is erected, the bags (1) are arranged over it and interconnected, and the compartments (4,5,6) are progressively filled from the innermost compartments (4) of the lowest bags to the or each outer compartment (6) at the crown of the arch, no compartment being filled until the next one or ones circumferentially lower and radially inner have been filled.

11. A method of assembling a shelter as claimed in claim 8 or 9, wherein the lining (2) is erected, the lowermost bags are positioned and filled from the innermost compartment (4) outwards, the next lowermost bags are positioned and similarly filled, and so on to the crown of the arch.

Patentansprüche

1. Ein Bunker mit einer bogenförmigen Verkleidung (2), welche wenigstens vorübergehenden einen Träger ausbildet, und einer externen, länglichen Ummantelung aus Säcken (1), welche sich im Wesentlichen horizontal erstrecken und mit einem Füllwerkstoff gefüllt sind, wobei die Säcke (1) dicht neben Einlässen (10) angeordnet sind, durch die der Füllwerkstoff eingefüllt wird, **dadurch gekennzeichnet, dass** die Säcke in Kammern unterteilt und derart montiert sind, dass die Kammern (4, 5, 6) eines jeden Sackes von der Verkleidung zunehmend beabstandet sind.

2. Ein Bunker nach Anspruch 1, wobei die Verkleidung ein geripptes Fachwerk (12) ist.

3. Ein Bunker nach Anspruch 1, wobei die Verkleidung ein starrer, blattförmiger Werkstoff (11) ist.

4. Ein Bunker nach einem der vorhergehenden Ansprüche, wobei wenigstens ein Teil des Füllwerkstoffes ein Granulatwerkstoff ist, welcher unverfestigt in den Säcken (1) verbleibt.

5. Ein Bunker nach einem der vorhergehenden Ansprüche, wobei wenigstens ein Teil des Füllwerkstoffes eine Kombination aus Substanzen ist, welche sich in den Säcken (1) verfestigen.

6. Ein Bunker nach einem der vorhergehenden Ansprüche, wobei Mittel zum formschlüssigen miteinander Verbinden benachbarter Säcke (1) vorgesehen sind.

7. Ein Bunker nach Anspruch 6, wobei das Verbindungsmittel längliche Elemente (9) sind, welche durch Schlaufen (7, 8) oder Augen greifen, die außen an den Säcken (1) angeordnet sind.

8. Ein Bunker nach einem der Ansprüche 1 bis 6, wobei benachbarte, aneinander anschlagende Flächen der Säcke (1) derart ausgebildet sind, dass benachbarte Säcke ineinander greifen.

9. Ein Bunker nach Anspruch 8, wobei jede Kammer (4, 5, 6) eines jeden Sackes zur benachbarten Kammer in Umfangsrichtung des Bogens teilweise versetzt ist, wodurch jede ineinander greifende Fläche aus Rippen und Nuten zusammengesetzt ist.

10. Ein Verfahren zum Zusammenbauen eines Bunkers gemäß Anspruch 6 oder 7, wobei die Verkleidung (2) aufgestellt wird, die Säcke (1) darüber angeordnet und miteinander verbunden werden und die Kammern (4, 5, 6) zunehmend von der innersten Kammer (4) des untersten Sackes zu der oder jeder äußeren Kammer (6) am Scheitel des Bogens gefüllt werden, wobei keine Kammer gefüllt wird, bevor nicht die in Umfangsrichtung weiter unten und radial weiter innen liegende nächste oder liegenden nächsten gefüllt worden ist oder sind.

11. Ein Verfahren zum Zusammenbauen eines Bunkers gemäß Anspruch 8 oder 9, wobei die Verkleidung (2) aufgestellt wird, die untersten Säcke angeordnet und ausgehend von der innersten Kammer (4) nach außen gefüllt werden, die nächsten untersten Säcke angeordnet werden und ähnlich gefüllt werden und so weiter bis zum Scheitel des Bogens.

Revendications

1. Abri comprenant un revêtement intérieur voûté (2) formant au moins un support temporaire et une enveloppe allongée externe de sacs (1) s'étendant généralement horizontalement et remplis d'une matière de remplissage, les sacs (1) étant fermés à part des entrées (10) à travers lesquelles la matière de remplissage est injectée, **CARACTERISÉ PAR LE FAIT QUE** les sacs sont compartimentés et sont assemblés avec les compartiments (4,5,6) de chaque sac progressivement espacés du revêtement intérieur.

2. Abri selon la revendication 1, dans lequel le revêtement intérieur est une ossature à nervures (12).

3. Abri selon la revendication 1, dans lequel le revêtement intérieur est une matière en feuille rigide (11).

4. Abri selon l'une quelconque des revendications précédentes, dans lequel au moins une partie de la matière de remplissage est une matière particulaire qui reste non solidifiée à l'intérieur des sacs (1).

5. Abri selon l'une quelconque des revendications précédentes, dans lequel au moins une partie de la matière de remplissage est une combinaison de substances qui se solidifient à l'intérieur des sacs (1).

6. Abri selon l'une quelconque des revendications précédentes, dans lequel des moyens sont prévus pour solidariser entre eux des sacs adjacents (1).

7. Abri selon la revendication 6, dans lequel les moyens d'interconnexion sont des éléments allongés (9), passés à travers des boucles (7, 8) ou oeillets disposés à l'extérieur des sacs (1).

8. Abri selon l'une des revendications 1 à 6, dans lequel des faces de butée adjacentes des sacs (1) sont formées de telle sorte que des sacs adjacents se coincent ensemble mutuellement.

9. Abri selon la revendication 8, dans lequel chaque compartiment (4, 5, 6) de chaque sac est partiellement décalé du compartiment adjacent à la périphérie de la voûte, faisant ainsi de chaque face de coincement un mélange de nervures et de rainures.

10. Procédé d'assemblage d'un abri tel que défini à l'une des revendications 6 ou 7, dans lequel le revêtement intérieur (2) est érigé, les sacs (1) sont disposés sur celui-ci et interconnectés, et les compartiments (4, 5, 6) sont progressivement remplis à partir des compartiments les plus internes (4) des sacs les plus bas jusqu'au ou jusqu'à chaque compartiment externe (6) au sommet de la voûte, aucun compartiment n'étant rempli tant que le suivant ou les suivants périphériquement inférieurs et radialement intérieurs n'ont pas été remplis.

11. Procédé d'assemblage d'un abri tel que défini à l'une des revendications 8 ou 9, dans lequel le revêtement intérieur (2) est érigé, les sacs les plus bas sont positionnés et remplis à partir du compartiment le plus interne (4) vers l'extérieur, les sacs les plus inférieurs suivants sont positionnés et remplis de façon analogue, et ainsi de suite jusqu'au sommet de la voûte.

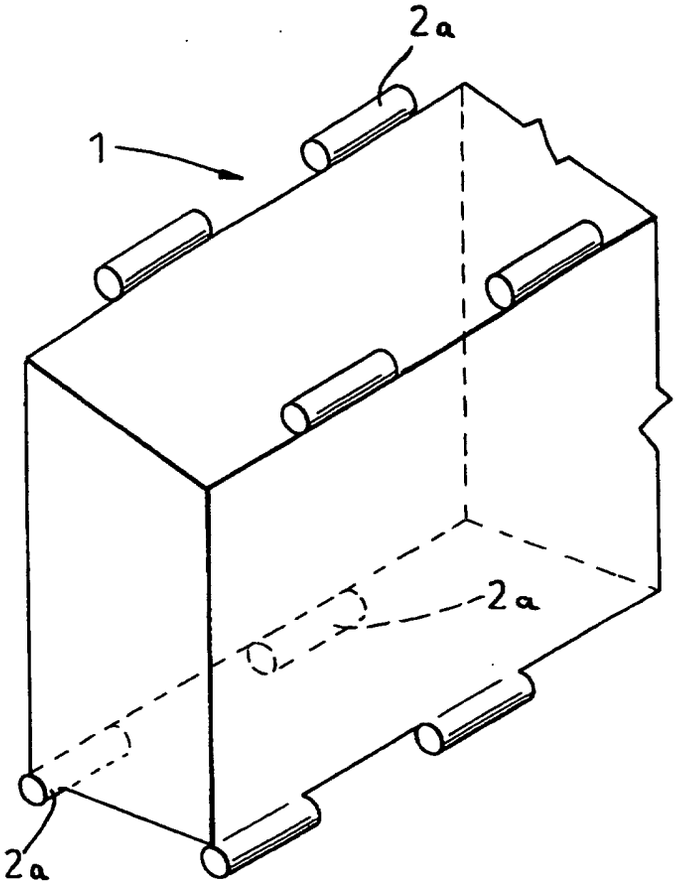


Fig. 1

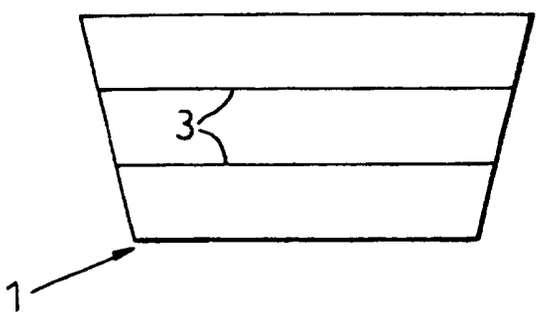


Fig. 2

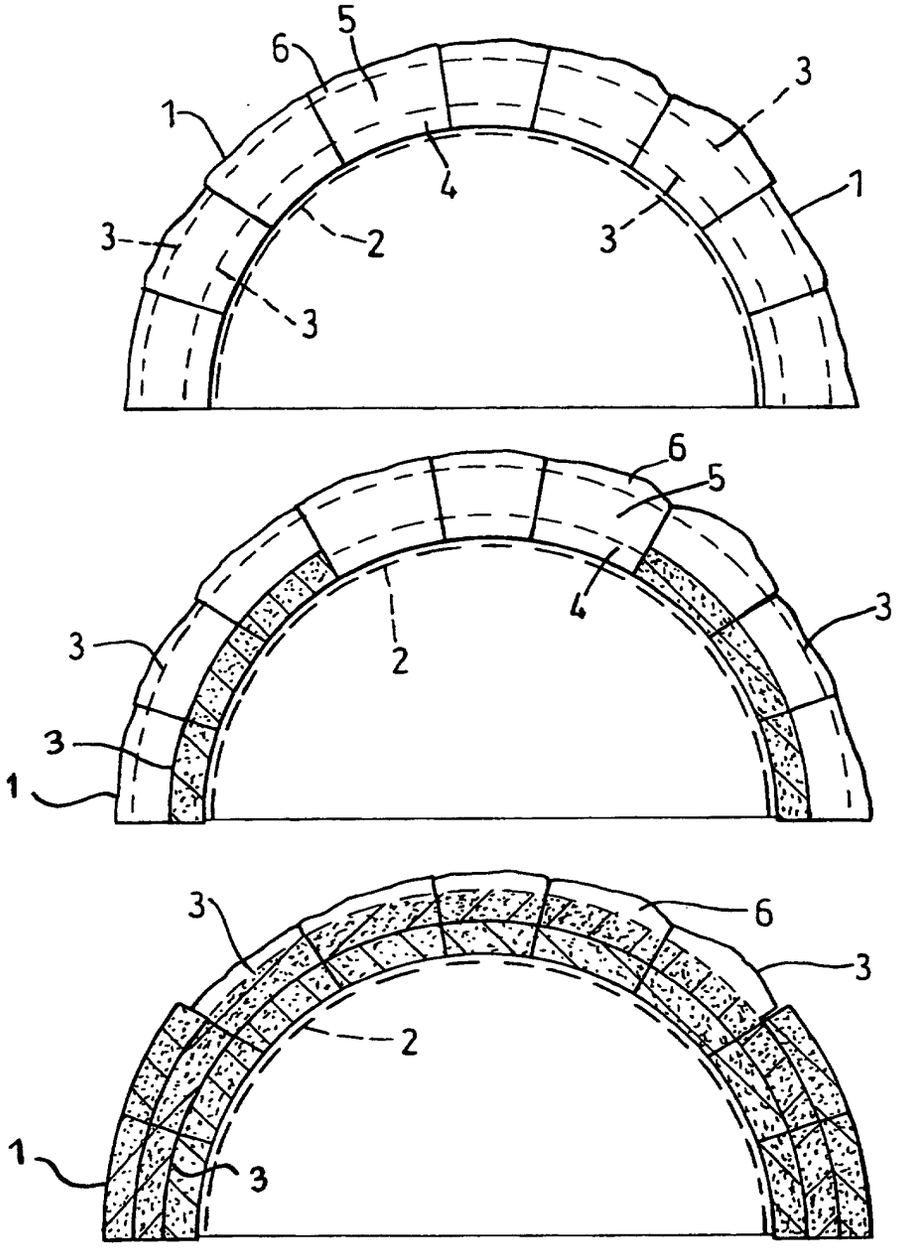
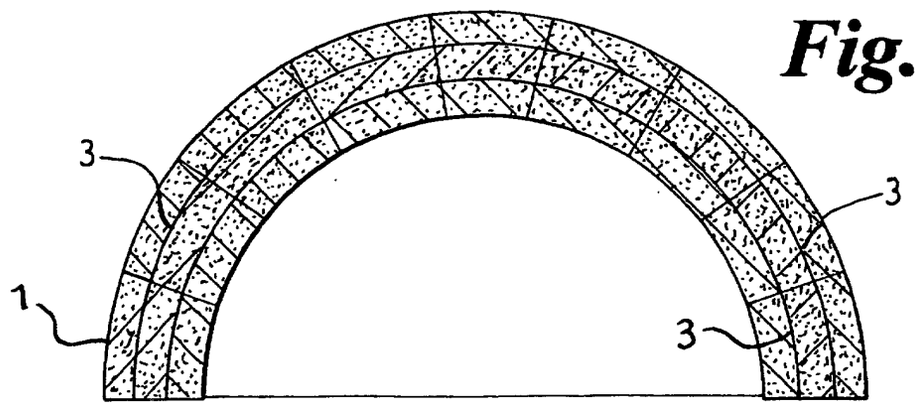


Fig. 3



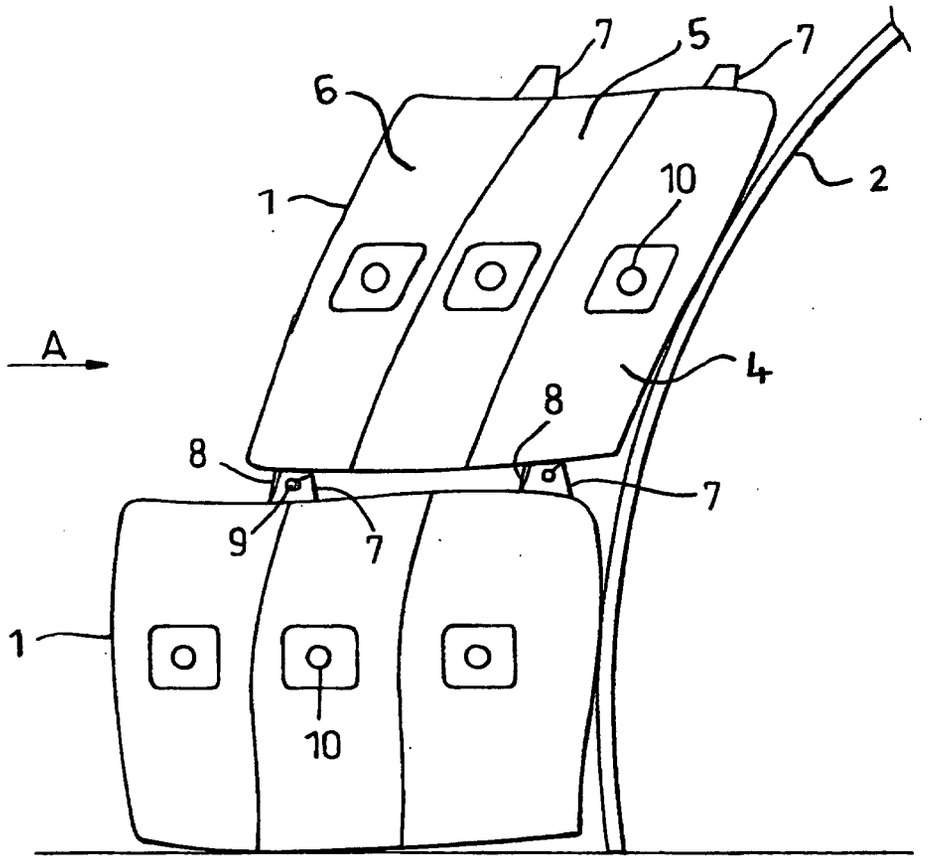


Fig. 4

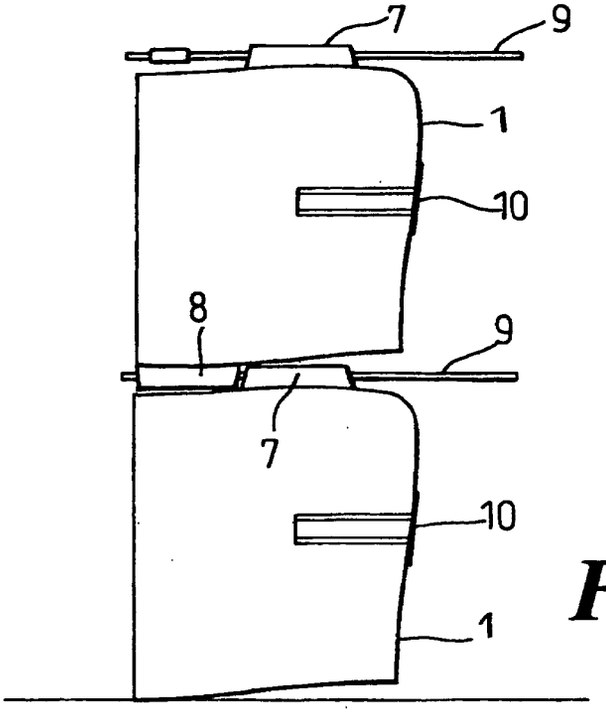


Fig. 5

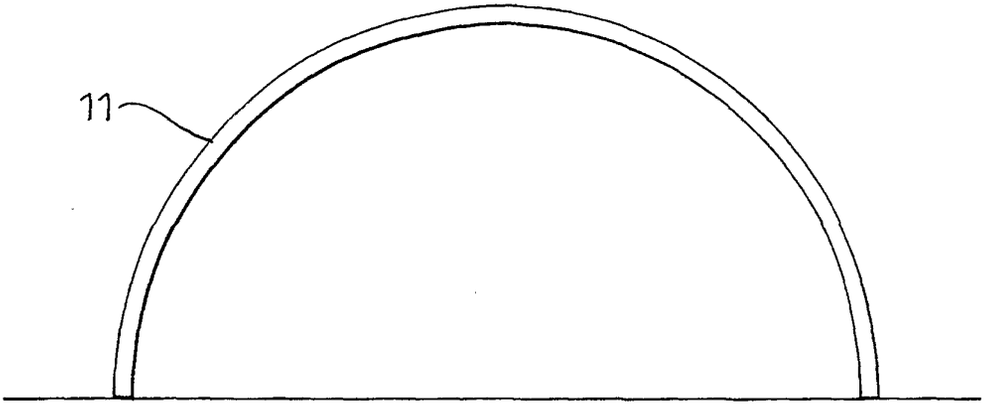


Fig. 6(a)

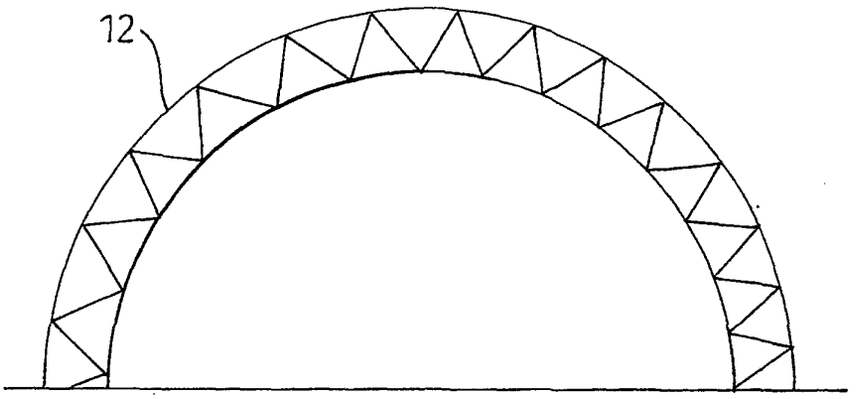


Fig. 6(b)

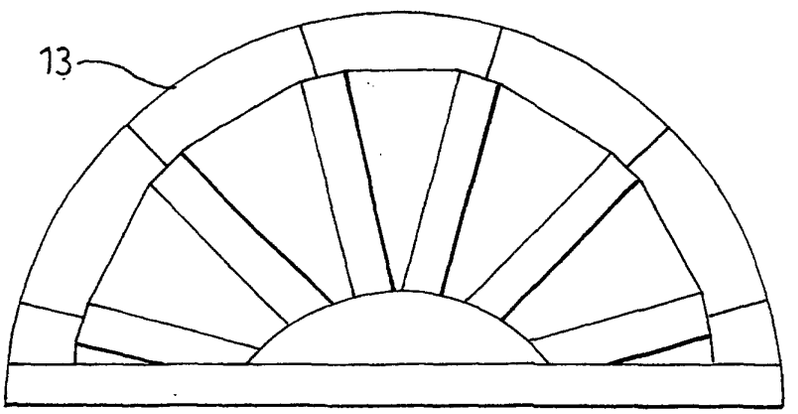


Fig. 6(c)

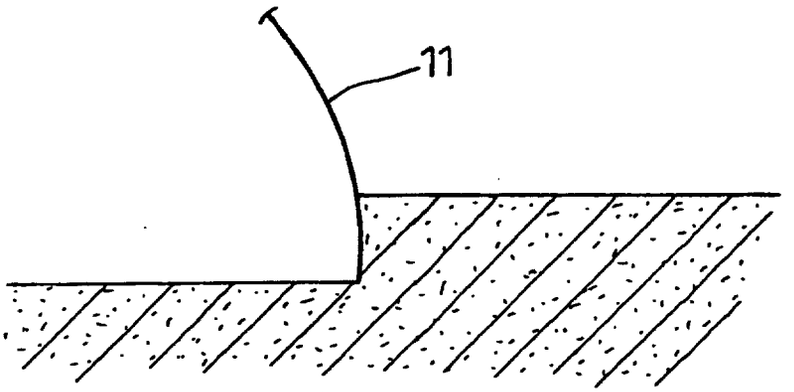


Fig. 7(a)

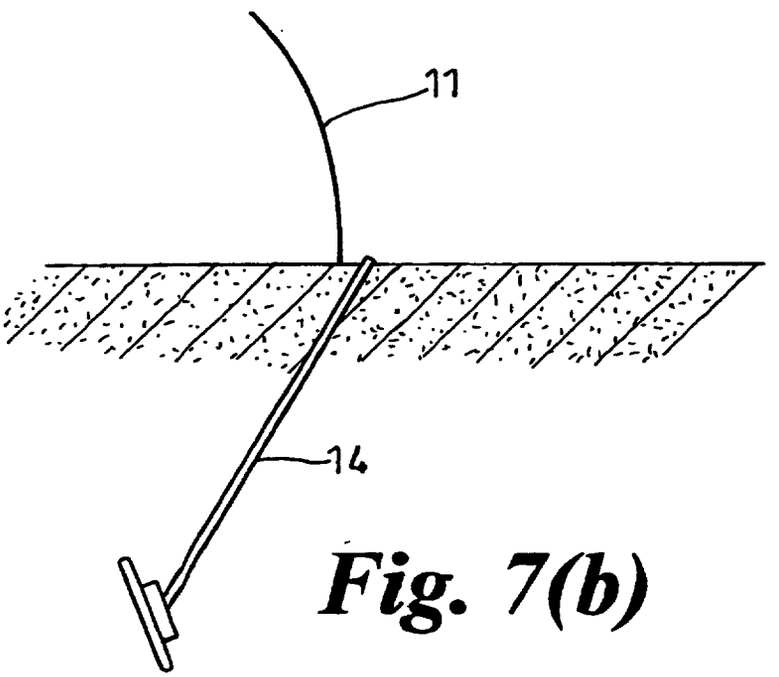


Fig. 7(b)

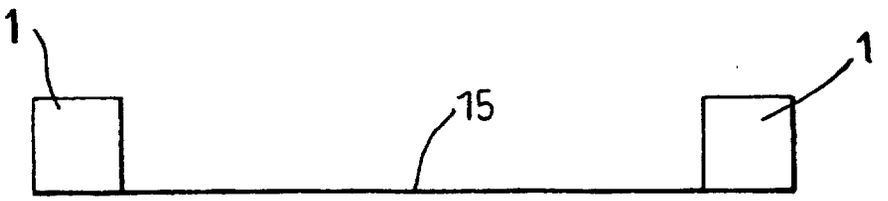


Fig. 7(c)

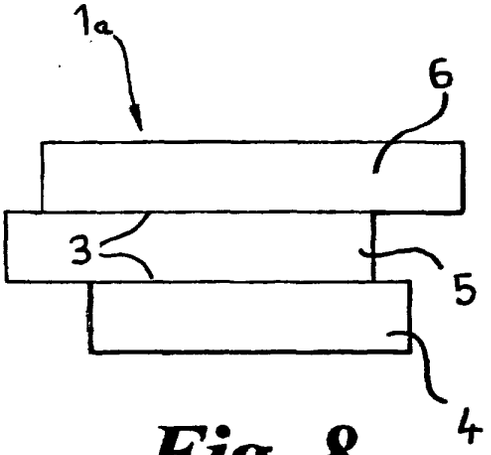


Fig. 8

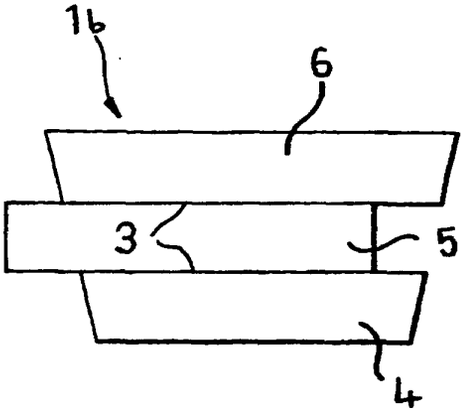


Fig. 9

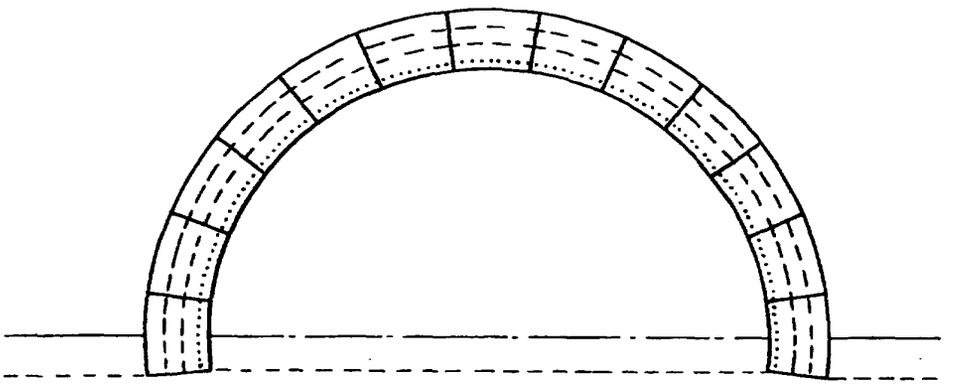


Fig. 10

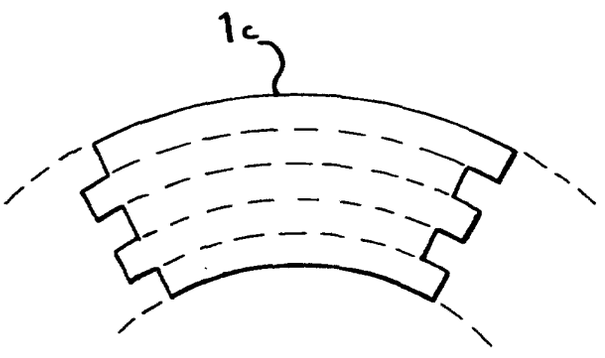


Fig. 11

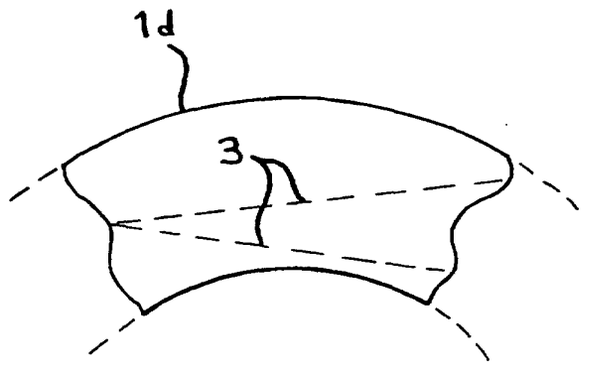


Fig. 12

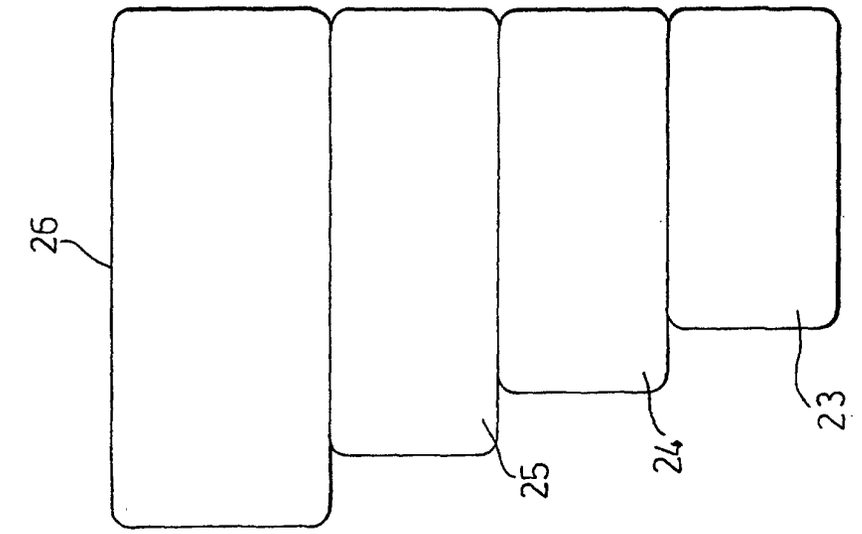


Fig. 13(c)

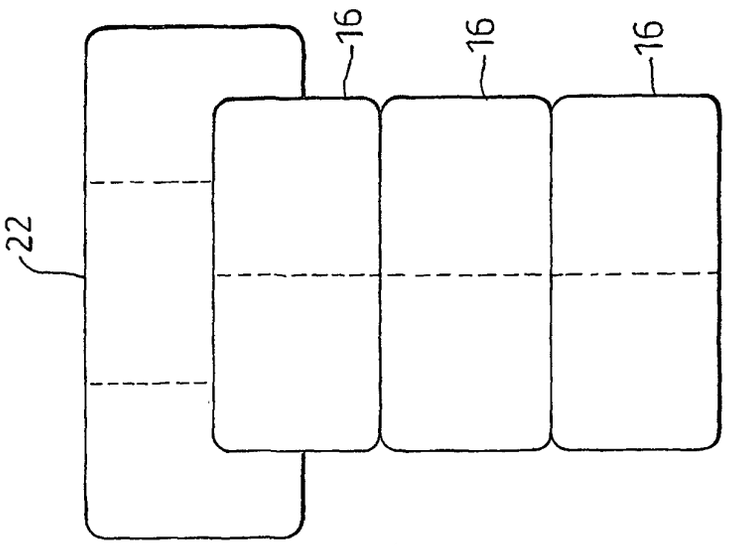


Fig. 13(b)

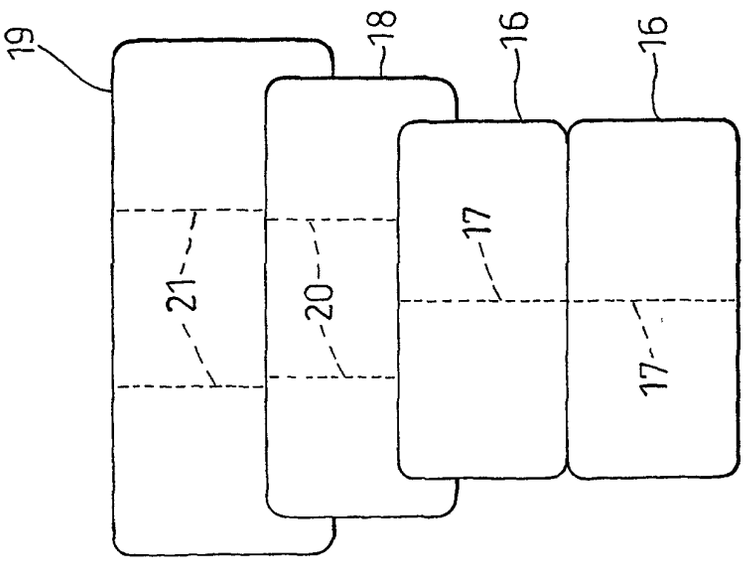


Fig. 13(a)