US 20090193740A1

(19) **United States**

(12) **Patent Application Publication**

Bennett

(10) **Pub. No.: US 2009/0193740 A1**

(43) **Pub. Date: Aug. 6, 2009**

(54) **COMPOSITE MASONRY BUILDING BLOCK**

(76) Inventor: **Kerry Robert Bennett**, New South Wales (AU)

Correspondence Address:
THE NATH LAW GROUP
112 South West Street
Alexandria, VA 22314 (US)

(21) Appl. No.: **11/794,661**

(22) PCT Filed: **Jan. 4, 2006**

(86) PCT No.: **PCT/AU06/00001**

§ 371 (c)(1),
(2), (4) Date: **Jul. 25, 2007**

(30) **Foreign Application Priority Data**

Jan. 4, 2005 (AU) 2005900005

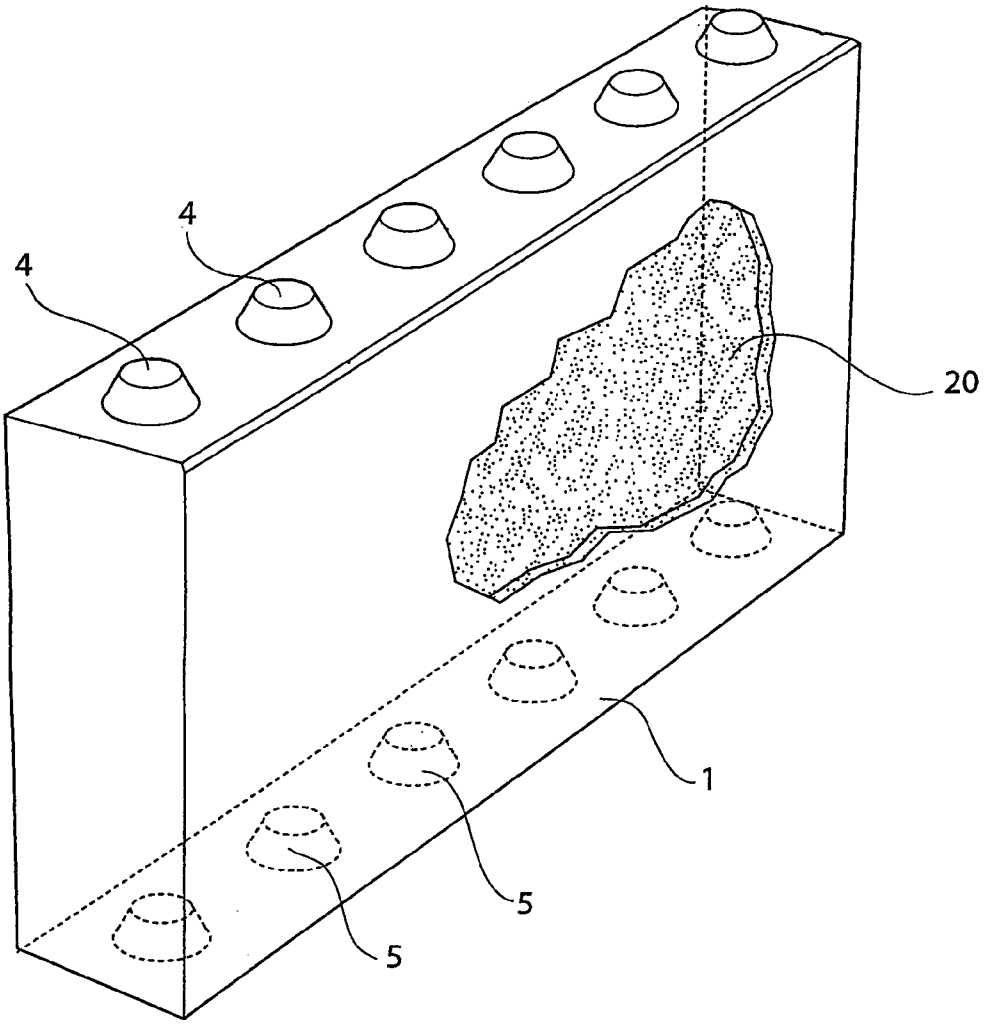
Publication Classification

(51) **Int. Cl.**
E04C 2/20 (2006.01)
E04C 2/04 (2006.01)

(52) **U.S. Cl.** **52/309.1**; 52/596; 52/309.13; 52/309.4

(57) **ABSTRACT**

A composite masonry building block (**1**) that has an inner core (**20**) of lighter density than an outer face and includes upper most protrusions (**4**, **73**) and matching lowermost cavities (**5**, **76**) to have an interlocking arrangement with other like blocks. Also disclosed is an inner lighter density material which includes an expanded plastic such as polystyrene with a cement binder. The upper (**2**) surface of the block (**1**) may include a plurality of protrusions and lower (**3**) may have a plurality of cavities (**5**). The arrangement of the protrusions (**4**) in relation to the upper surface (**2**) and the arrangement of cavities (**5**) in relation to lower surface (**3**) are such that the protrusions (**4**) will locate within and interlock with the consistently aligned and placed cavities of the adjacent block.



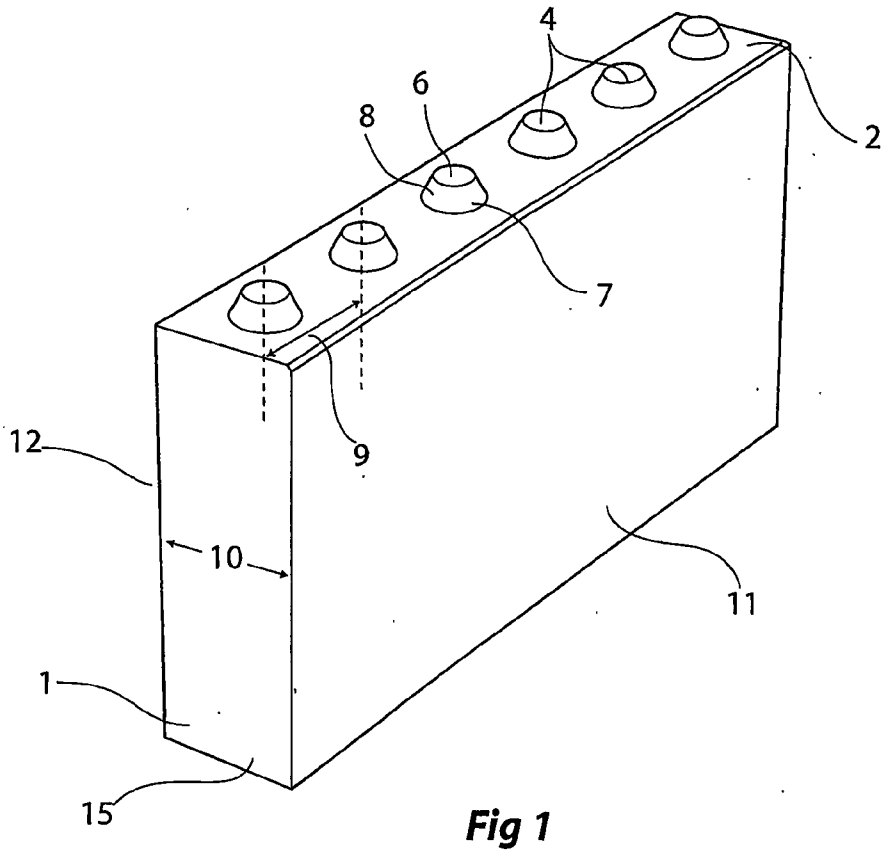


Fig 1

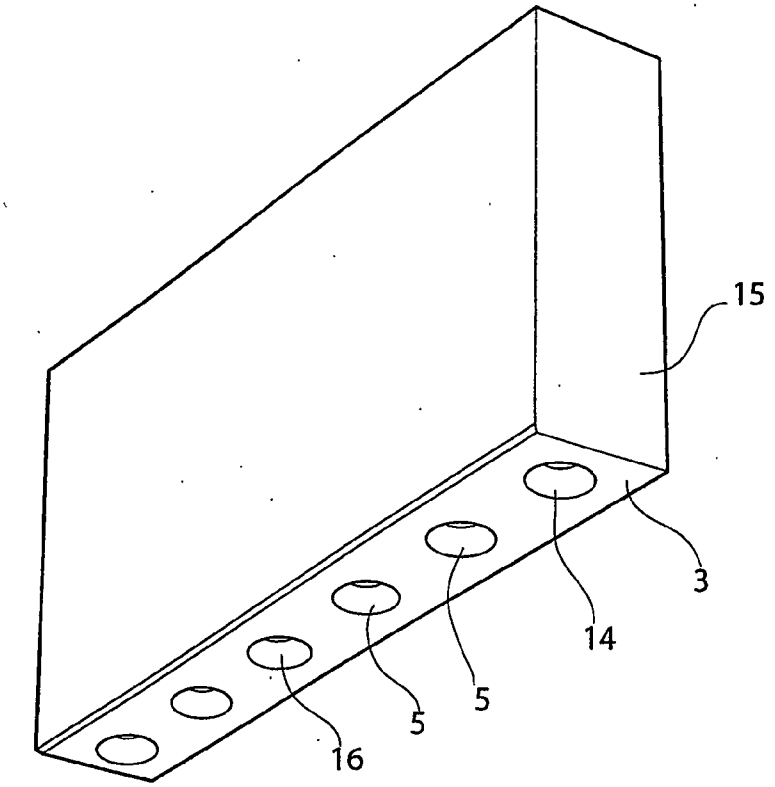


Fig 2

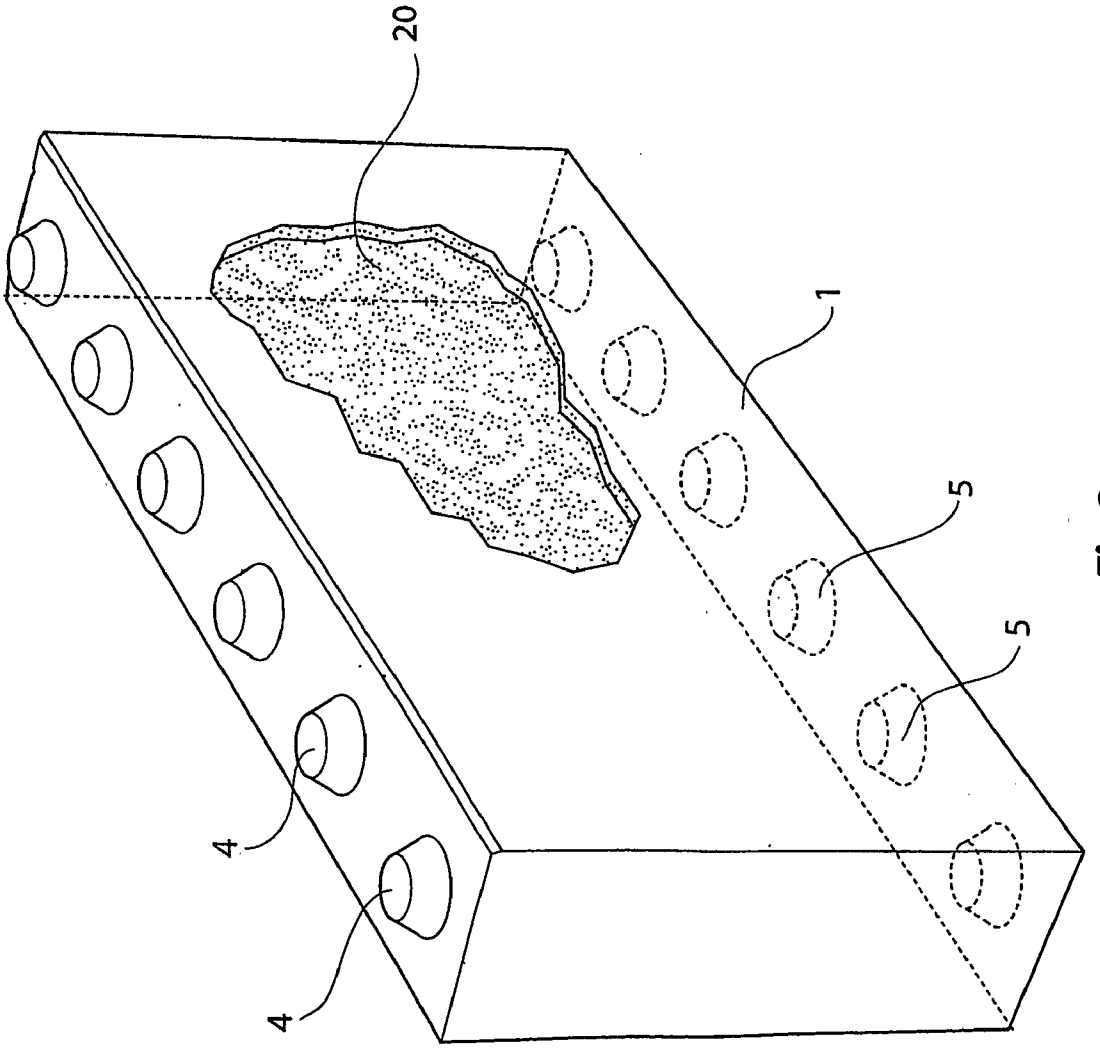


Fig 3

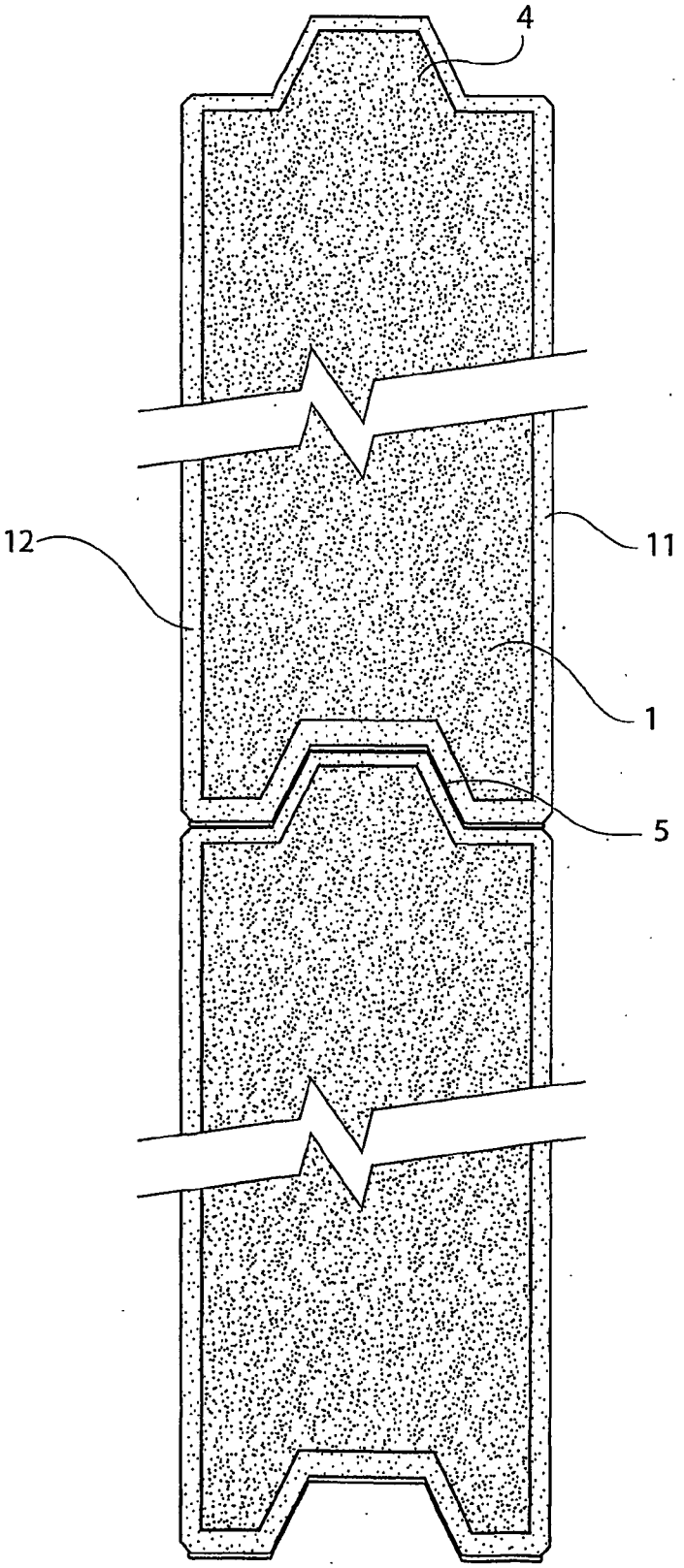


Fig 4

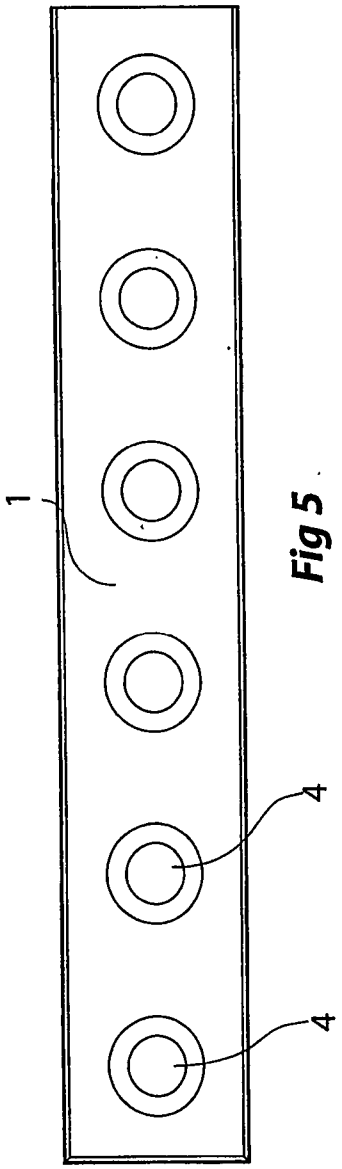


Fig 5

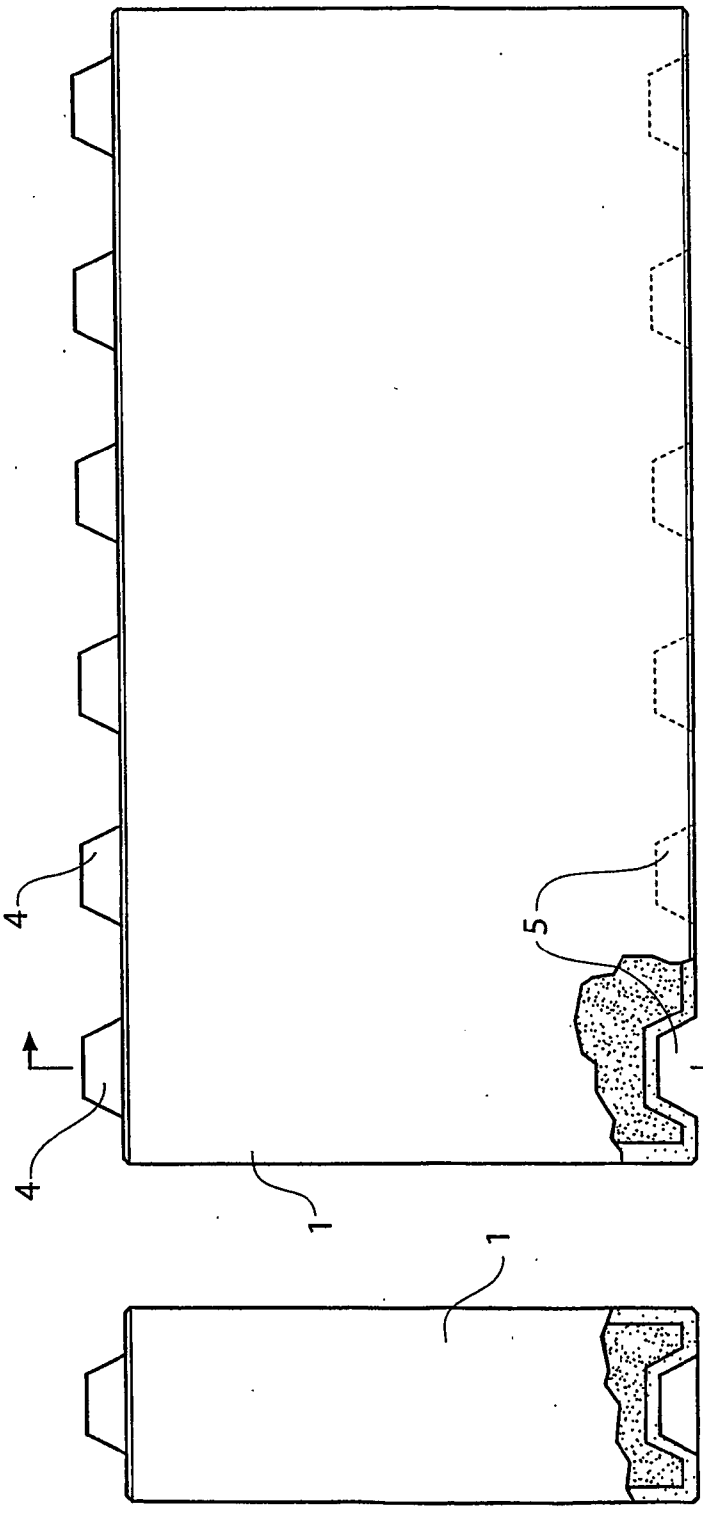


Fig 7

Fig 6

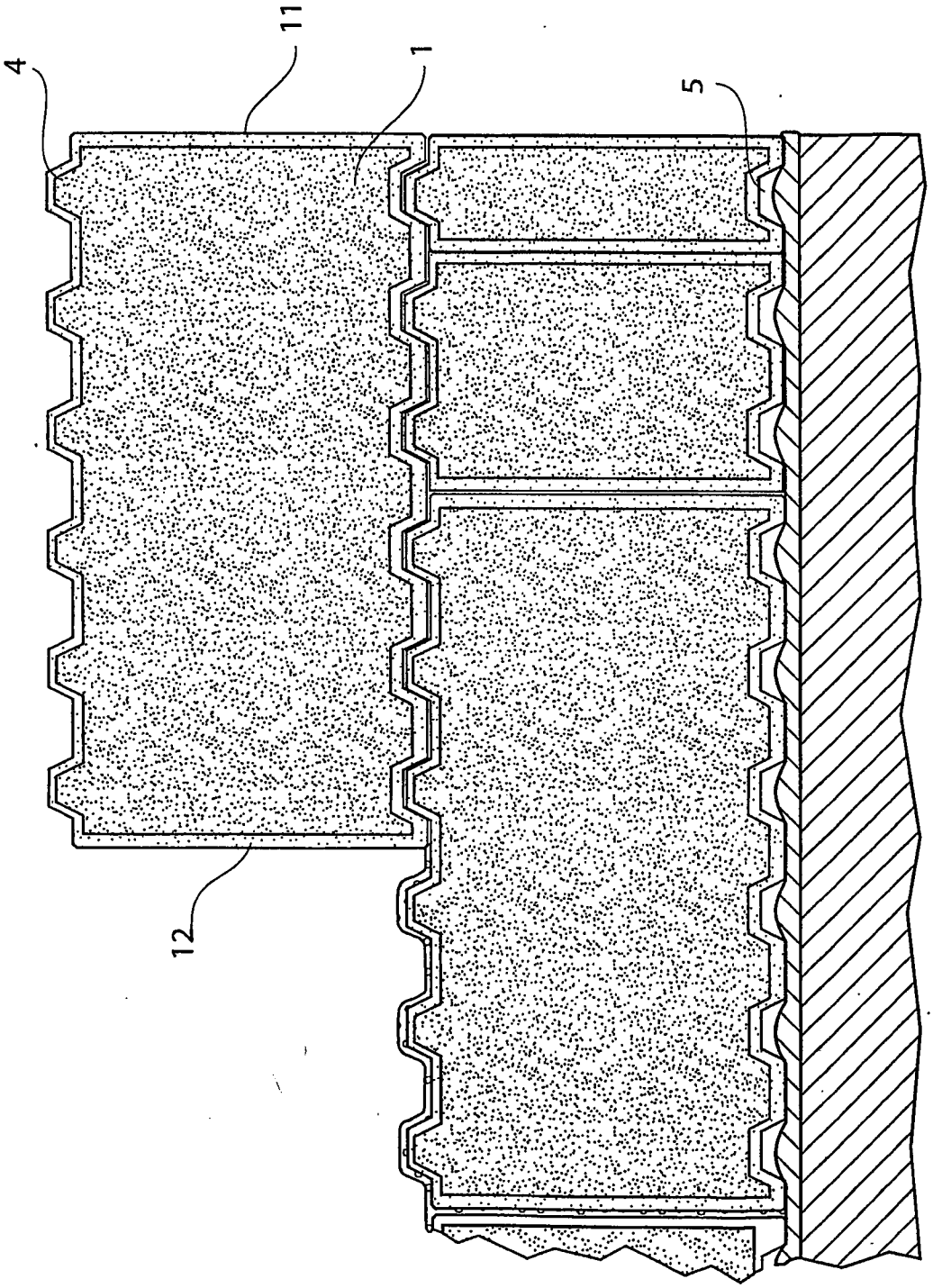


Fig 8

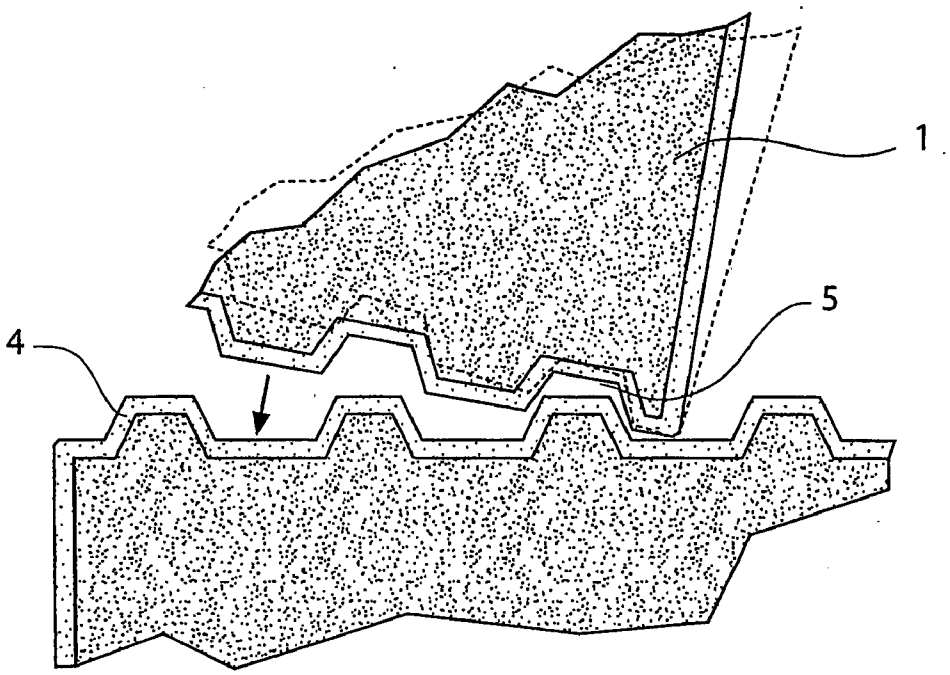


Fig 9

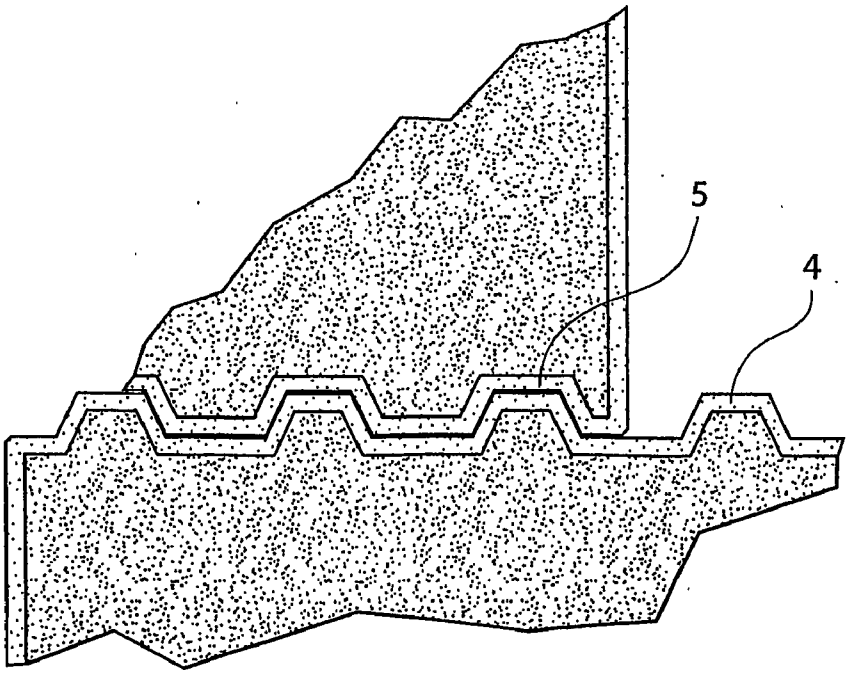


Fig 10

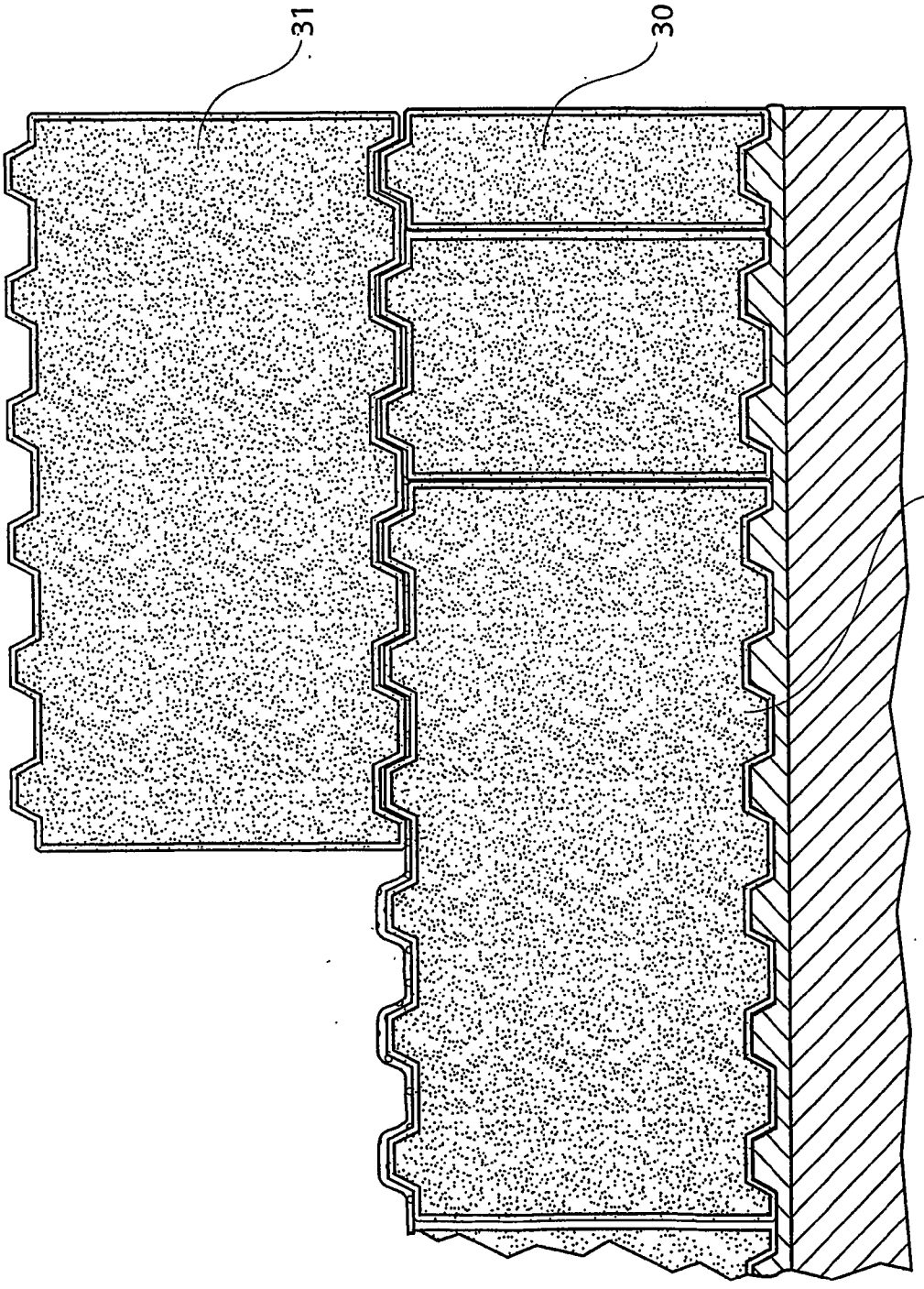


Fig 11

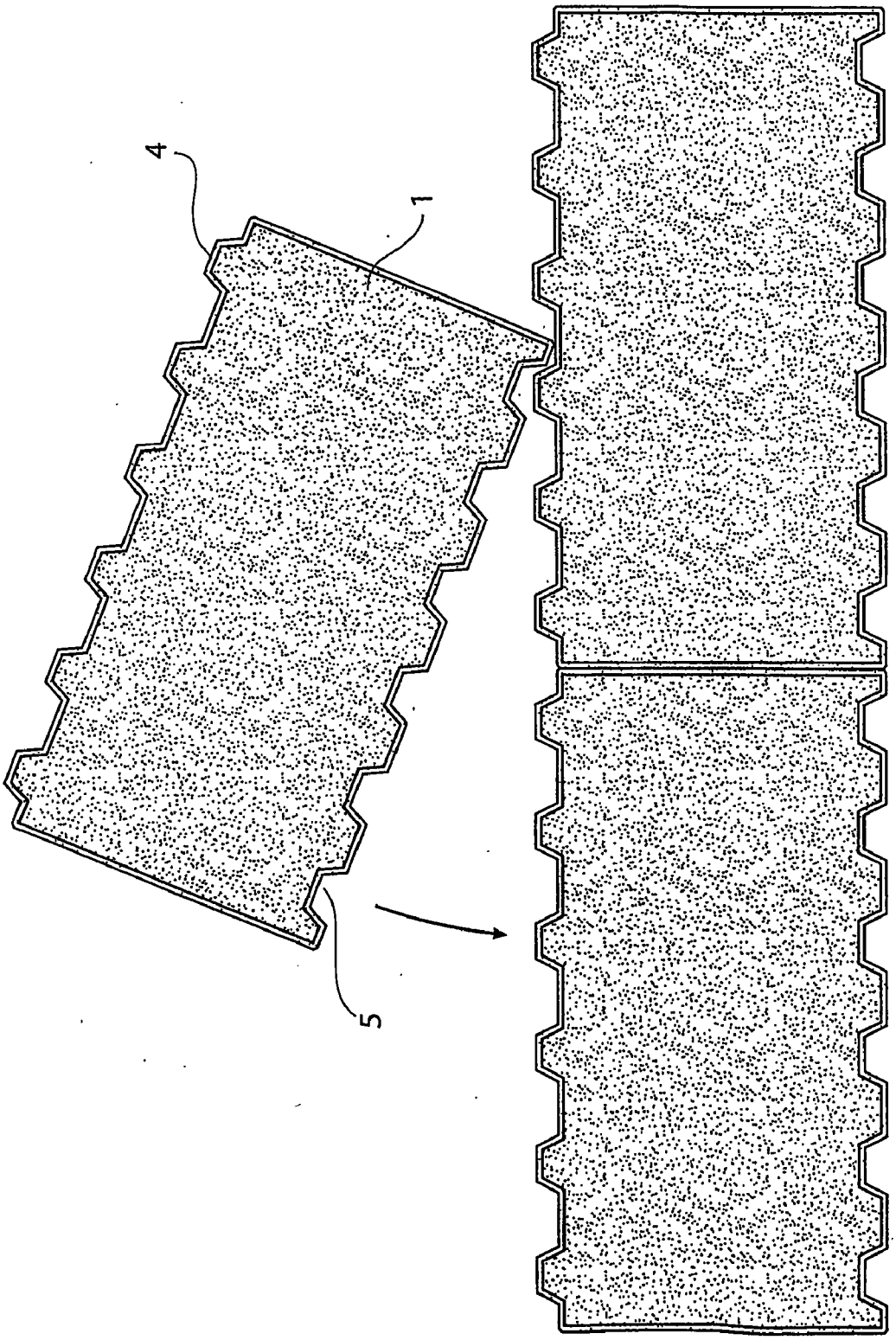


Fig 12

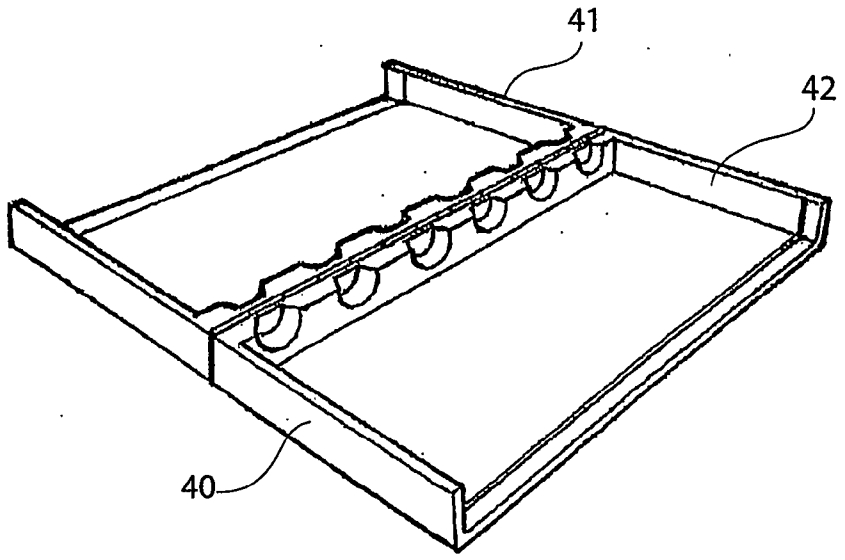


Fig 13

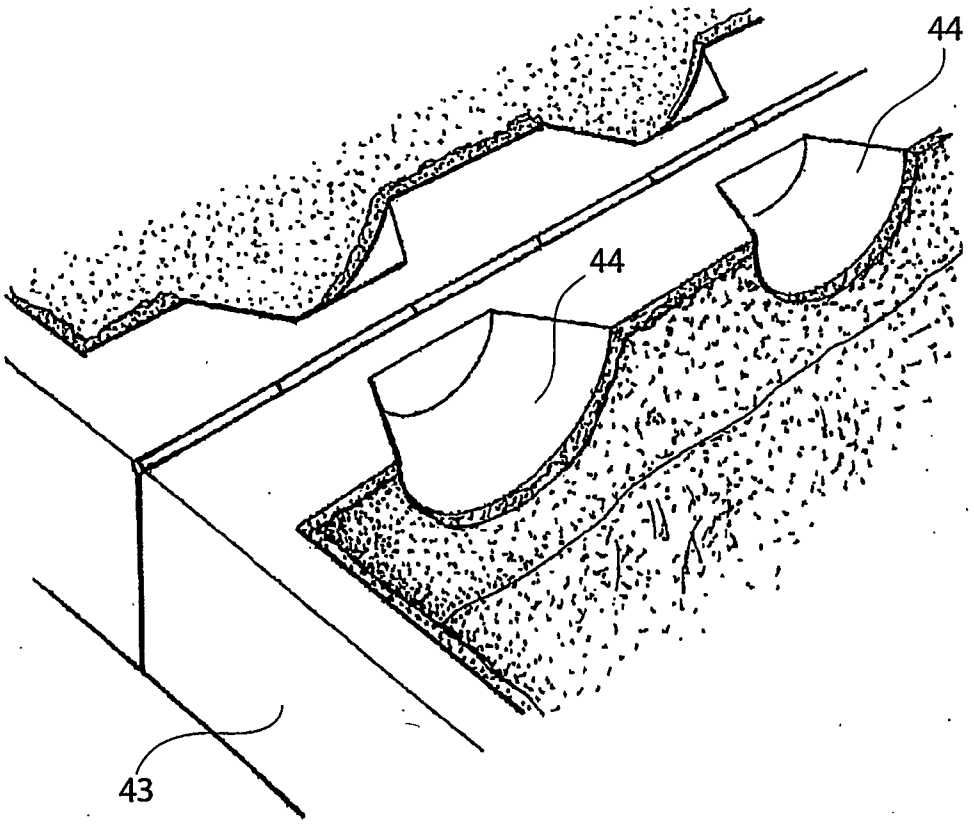


Fig 14

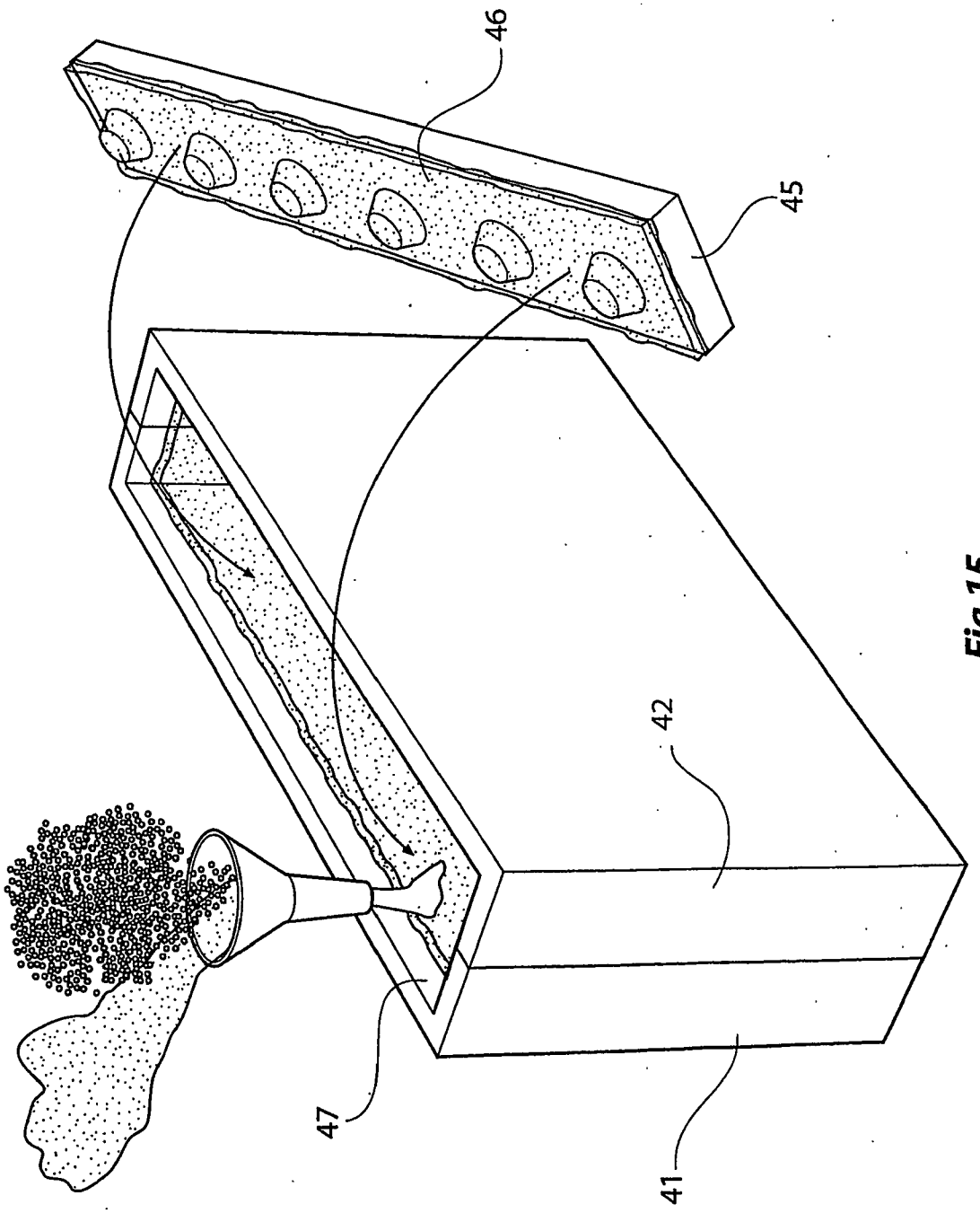


Fig 15

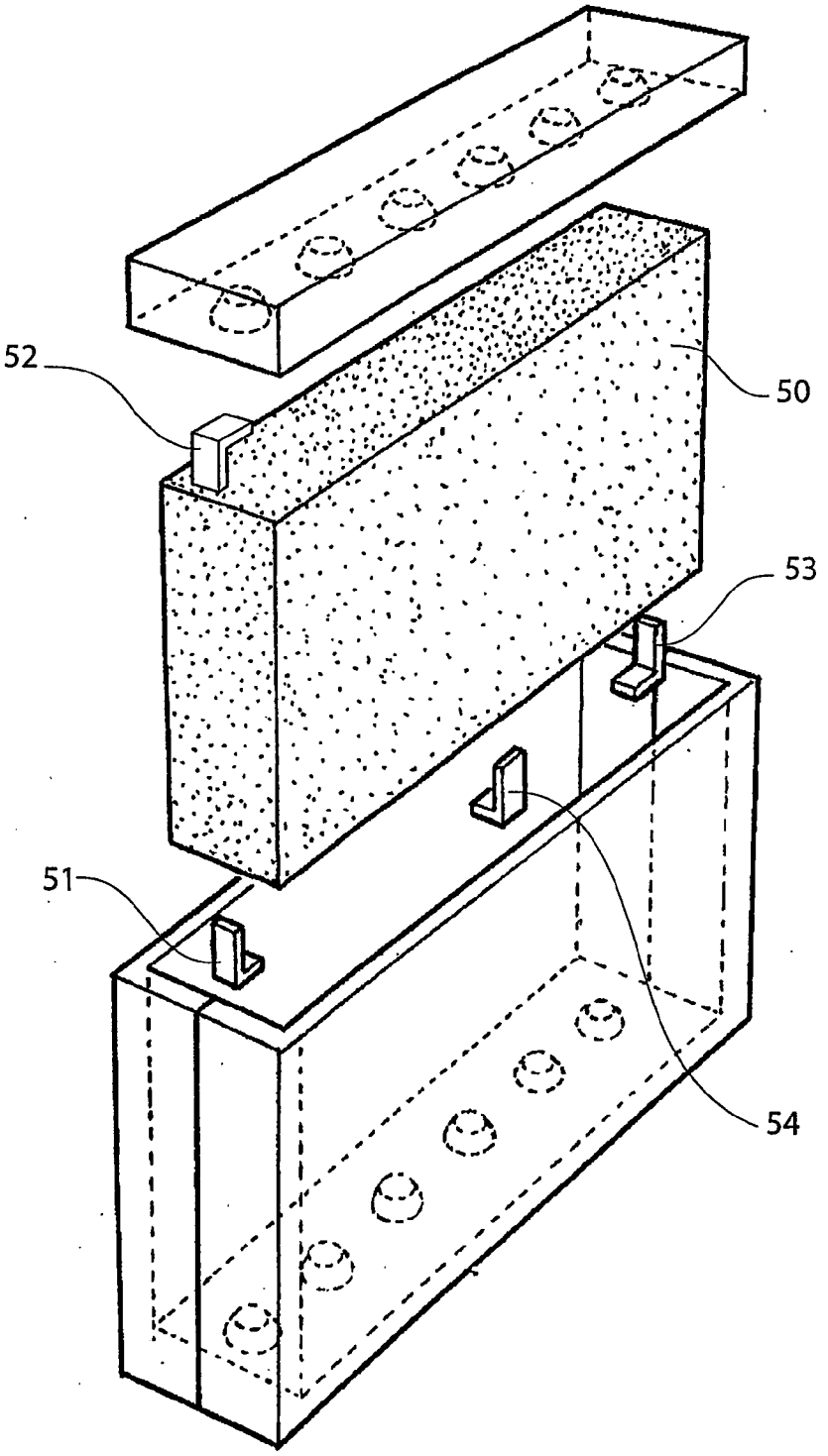


Fig 16

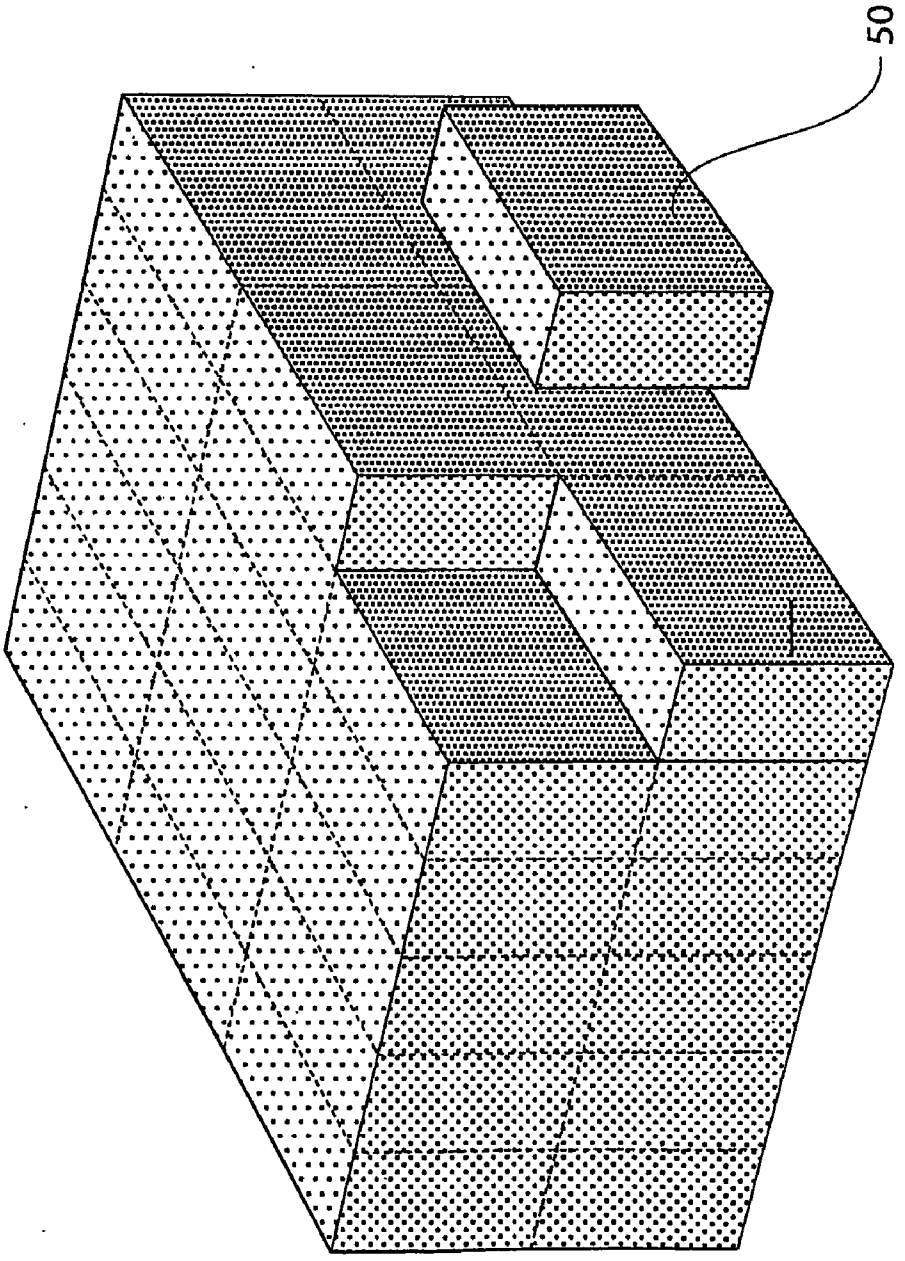


Fig 17

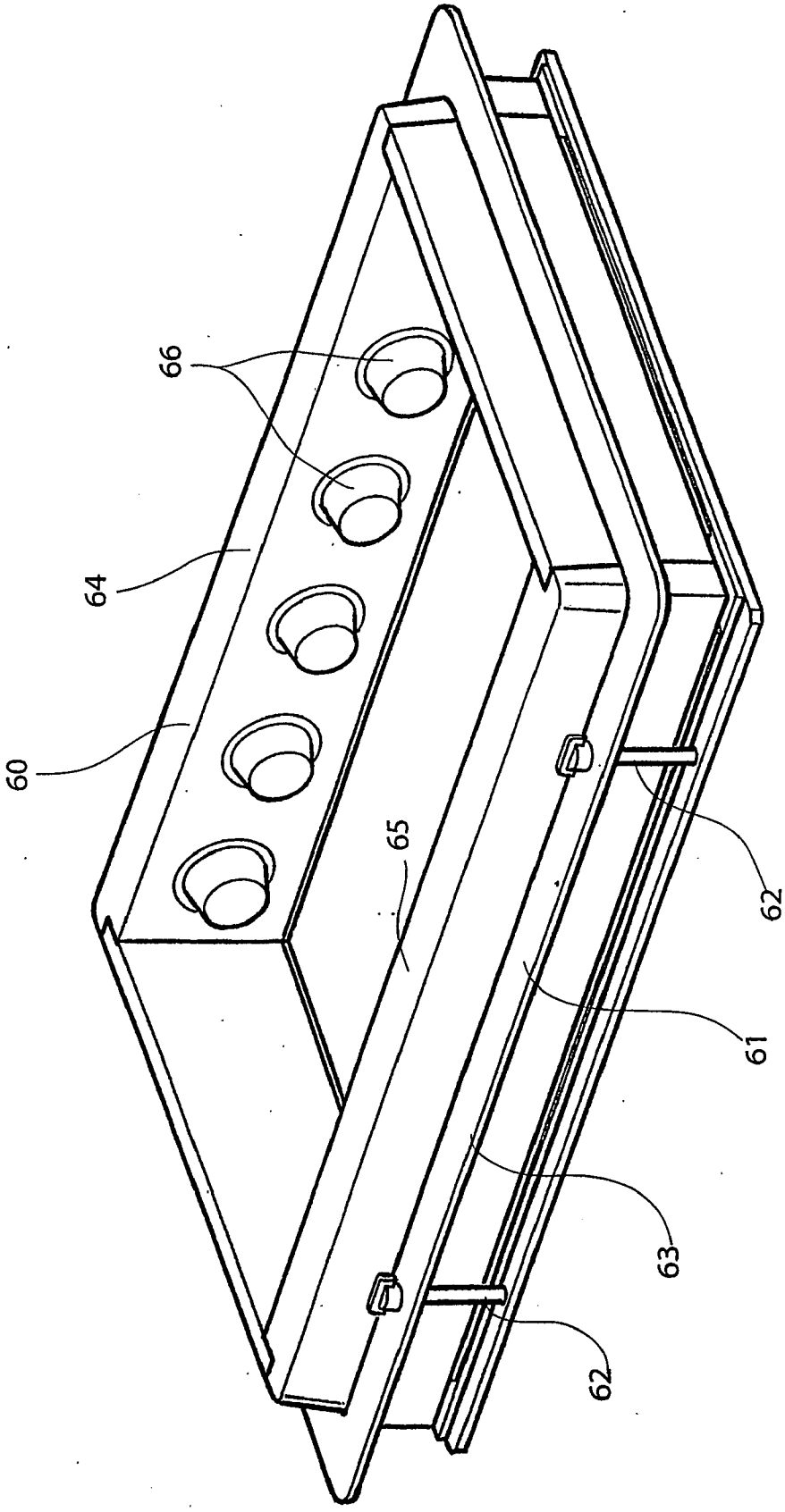


Fig 18

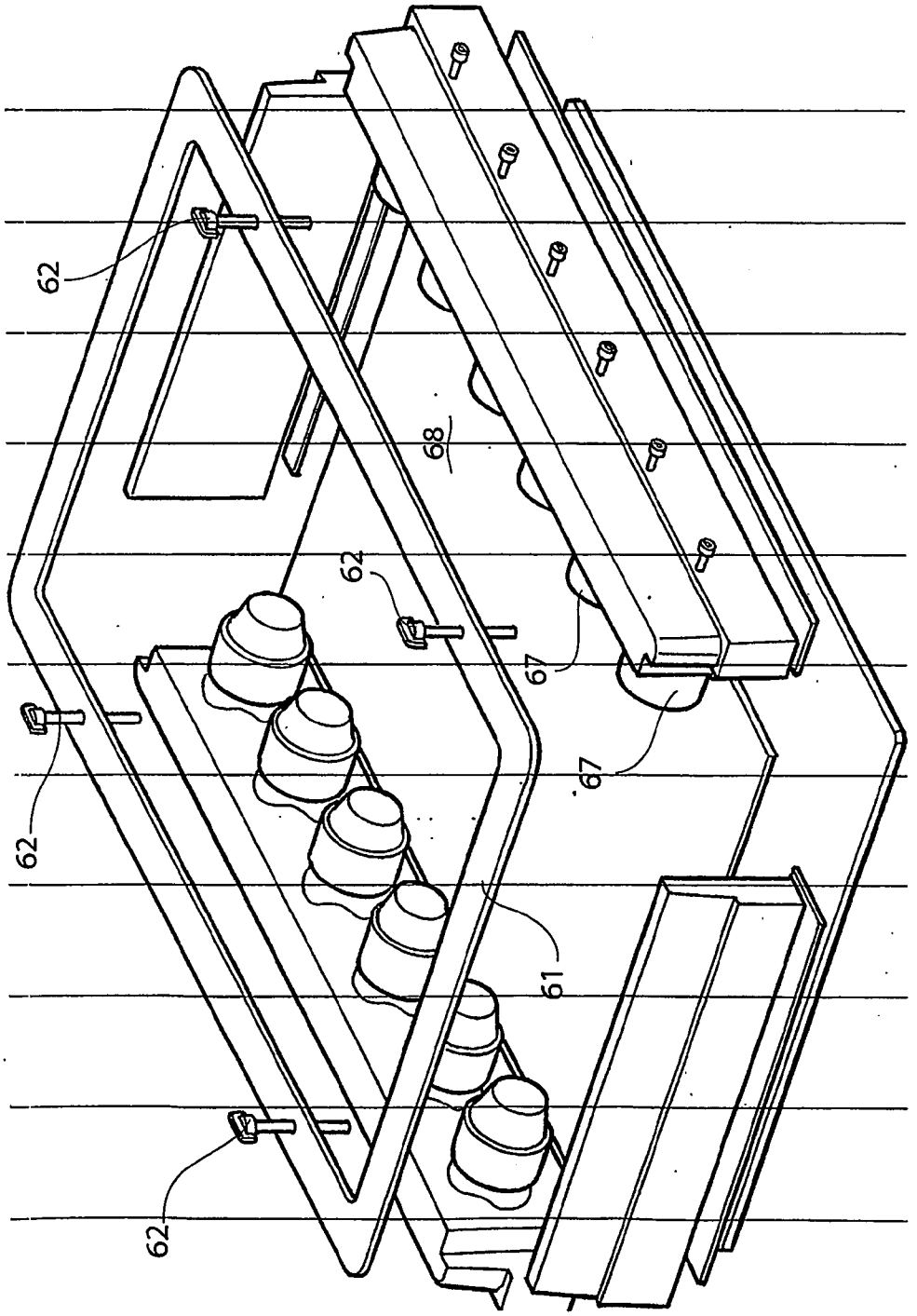


Fig 19

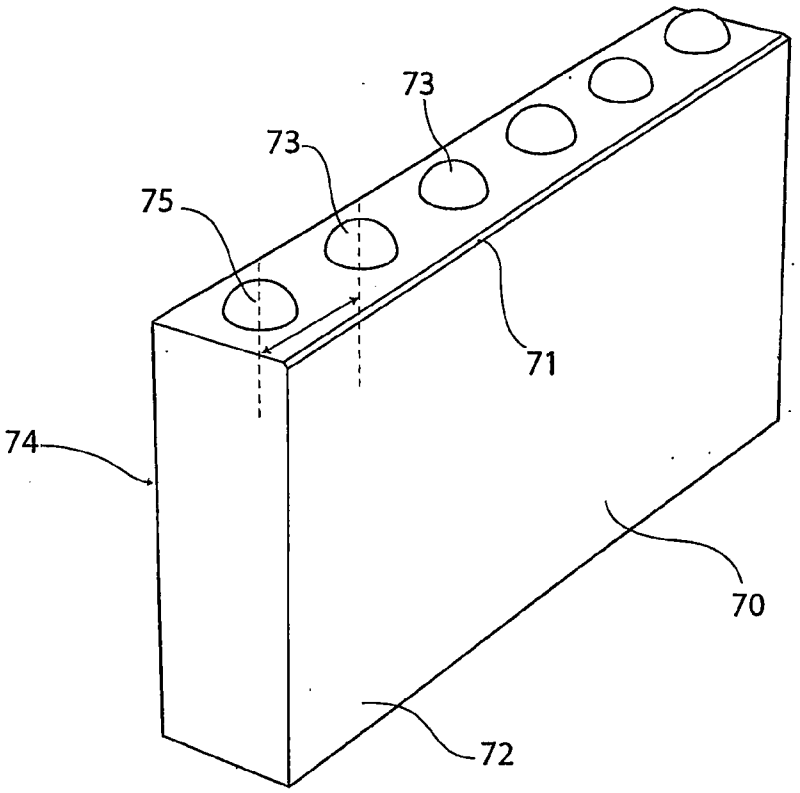


Fig 20

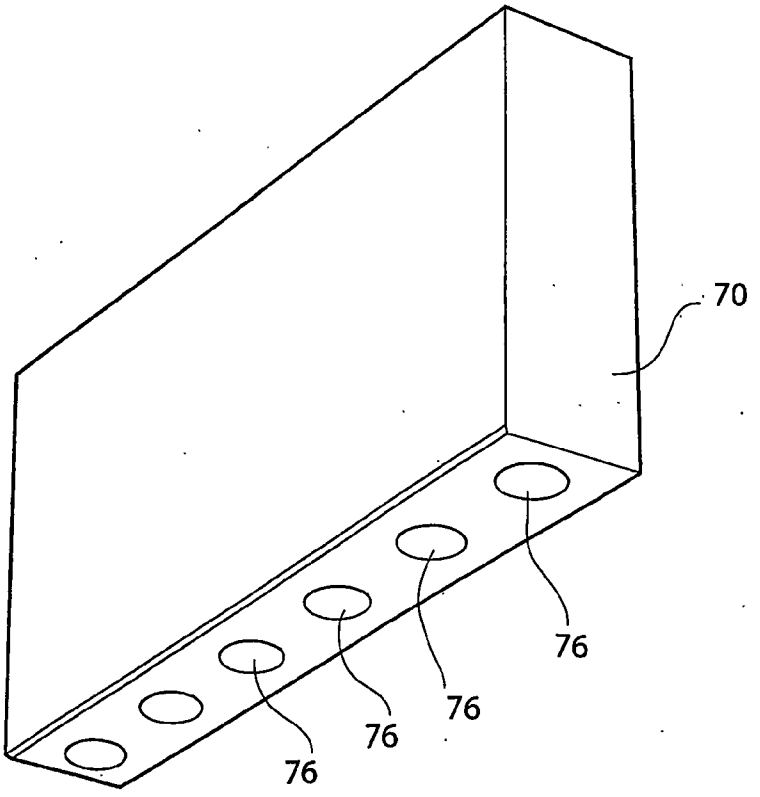


Fig 21

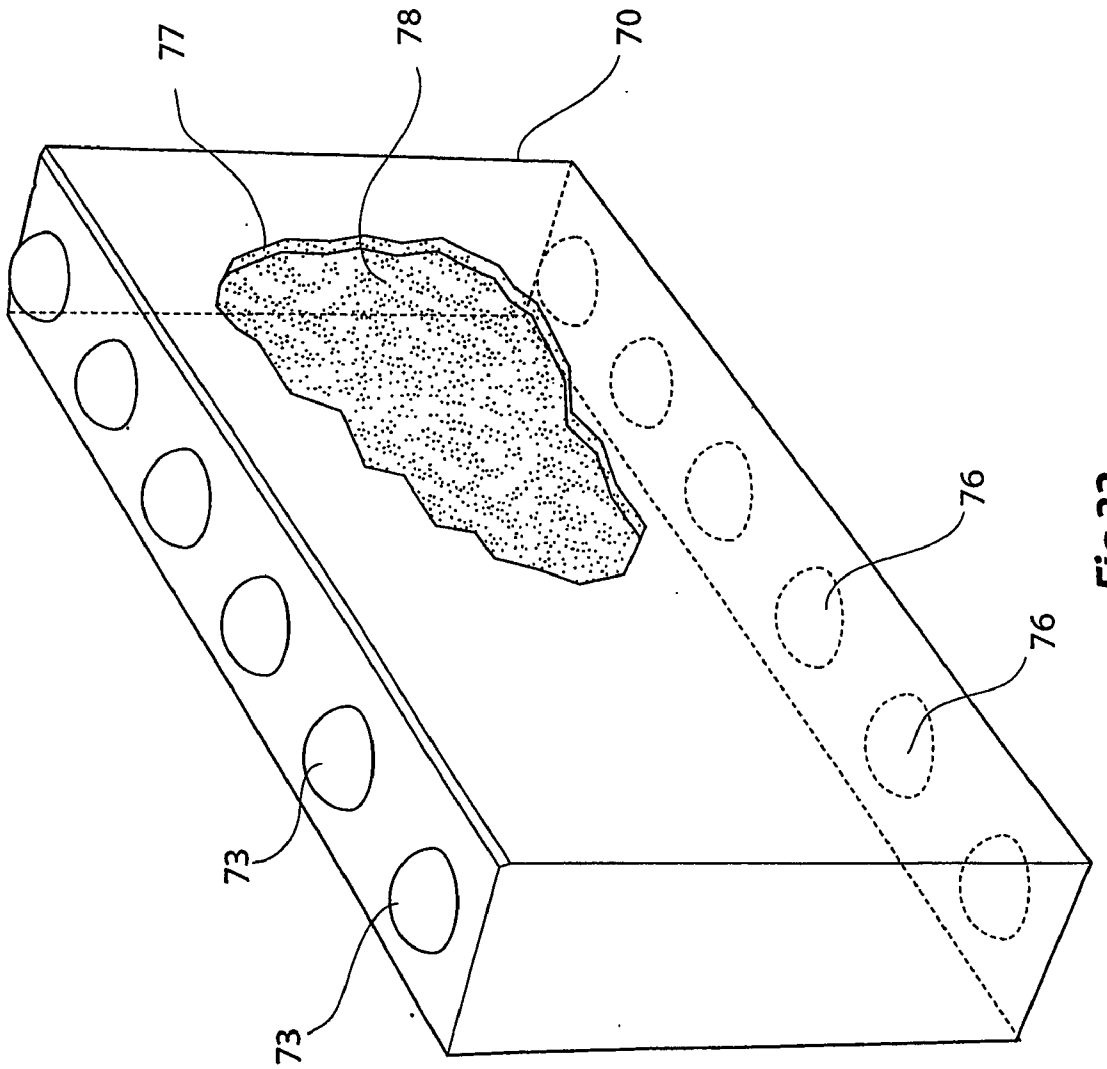


Fig 22

COMPOSITE MASONRY BUILDING BLOCK

TECHNICAL FIELD

[0001] This invention relates to building blocks, to a method of constructing a building, a method of constructing a building block and an assembly of building blocks.

[0002] The art to which this invention is generally directed is the art referred to generally as "masonry" and "masonry blocks" where building blocks are constructed that can be assembled one upon the other to form a masonry wall.

BACKGROUND ART

[0003] Baked clay bricks have been known for many centuries but more recently cement blocks have been manufactured which are used to construct walls of buildings.

[0004] Existing concrete blocks as they are currently manufactured are used in walls by using a mortar bed and vertical mortar join.

[0005] A characteristic of existing concrete blocks is that they are very porous and it is considered that this is an economically useful characteristic of concrete blocks as currently manufactured because, in order for these to be economic, they are formed using a very dry concrete mix so that their form is established within a mould in such a way that they can then be very quickly removed and left to then set separate from a mould.

[0006] A conventional concrete block formed in this way is also conventionally formed with one or more hollow centres with an open top and bottom.

[0007] This of course allows for a bigger overall dimension of a block while keeping all up weight for such an overall dimension less than would be the case with a solid

[0008] There still, however, is required considerable skill in laying such blocks using mortar beds and having to adjust for each individual block, its relative position both vertically and horizontally and laterally one in relation to another.

[0009] Further, for reasons of economy a unit size of concrete blocks of current type are relatively heavy and this creates a challenge for a skilled bricklayer who must not only lift the brick into position, but must also apply mortar to at least one end of the brick and then once lifted into position, manipulate this.

[0010] This then calls for bricklayers having the ability to be skilled in aligning such blocks but also to be physically strong to achieve this further manipulation.

[0011] A further difficulty then arises because of the porous nature of the block and further processes, perhaps for instance, rendering of the face of any wall which is then more often needed to assist in ensuring a wall will provide a sufficient protective wall for purposes of a building.

[0012] It is also true that conventional masonry bricks have existed for a very long time indeed and have established a long tradition of ensuring that a masonry wall is constructed by using individual bricks laid one upon the other with an intervening mortar base of some thickness and especially where this is intended to be a visible wall providing, for instance, a visible face, then skill and therefore cost remain considerable.

[0013] An object of this invention is to propose a block which can be used to construct masonry walls, as well as a wall as such and a method of building all of which facilitate a cost saving at least in the eventual product, for instance when using a block, and that such savings can be achieved while at least maintaining a construction that will meet required building standards.

DISCLOSURE OF THE INVENTION

[0014] In one form of the invention, there is proposed a composite masonry building block which has an outer facing material that is formed as a wet cast cement-based material based material and has a core of a material or materials which are of less density than the outer wet cast cement based material.

[0015] In preference, the wet cast cement based material is a mixture of an extender and a binder.

[0016] In preference the wet cast cement based material is a mixture of an extender such as sand and a binder such as a cement such as Portland cement.

[0017] An advantage of this arrangement is that such a block can, by reason of the nature of wet cast cement material have an outer surface which is of low or negligible porosity and it also can be made to a high degree of accuracy.

[0018] Further, wet cast cement based material as a material can also be therefore implicitly strong in the context of masonry products so that instead of using a mortar bed for joining one block upon another, there can now be an adhesive.

[0019] A core or body of the block by being faced by the wet cast cement based material can be protected and therefore the type of material that can then be used allows for a large block in physical size which nonetheless does not then weigh a proportionately significantly greater weight.

[0020] In other words, a desirable weight considering the lifting capacity of a worker might be up to let us say typically approximately 14 kg, so that by reducing in the body, the density of the materials, we then have the possibility of a much larger block for the same all up weight.

[0021] In preference in this invention, it is proposed that the material of lighter density be expanded plastics material with a binder.

[0022] In preference, such a binder can be a wet cast cement based material that then would be expected to be compatible with the outer surface material.

[0023] In preference then, there is proposed a core which is comprised of at least in the main, by volume, expanded polystyrene foam and a binder selected from materials where these are compatible both with expanded polystyrene foam and the outer wet cast cement based material whether this is a facing on one face only or on a back and front face or as fully surrounding material.

[0024] If there is no longer necessity for such a block when being laid to then need to be aligned significantly every time on a bed of mortar with an end also of considerable thickness of mortar, the skill required for laying such blocks is much less. By having accurately sized and implicitly protected blocks means that the job of laying then might include coating appropriate surfaces with an adhesive as is commonly used in the building industry and then simply placing blocks one upon the other where an adhesive layer as compared to a mortar bed will be able to have very much less thickness.

[0025] Because a glue or adhesive material is intended to be a material that of itself does not need to and does in fact not provide significant bulk, one can afford to have a more expensive material for an effective bonding which then can provide significant adhesion between respective matching surfaces.

[0026] One of the problems with a block using features described above is that there still needs to be a modest level of

skill in ensuring that each block is appropriately positioned both in vertical alignment and horizontal alignment even though with respect to horizontal alignment, this will depend upon base levels and have some dependency upon maintaining only a relatively constant thickness of any adhesive.

[0027] We have described the features according to this invention hitherto without specifying precisely any of the external shape characteristics of a brick as far as its external shape is concerned.

[0028] In preference then the block has an overall appropriate shape which can include curved surfaces but in a preferred example is of rectangular proportions in which there are two opposite faces providing an outer face and an inner face, two end faces and a top and bottom face.

[0029] If these respective faces are all orthogonally aligned one with respect to the other at least generally, then we have a rectangular block.

[0030] With respect to the skill required, however, in terms of building a wall using such features in a block, it would be desirable if there could be an even greater reduction in the skill required for the person laying the blocks.

[0031] In accordance with this invention then there are further provided one or more projections in a one of the faces of the block and one more cavities corresponding in being a matching shape and position relative to the matching shapes in the opposed face within a second oppositely positioned face of the block.

[0032] In preference, there are a plurality of projections on an upper face that are spaced apart an equal distance and such that such projections can be used by matching cavities by a block which is either aligned at right angles to the first said block or overlaps the said block only by a proportion of the total length of the block.

[0033] In preference then, there is a matching relationship between a distance apart of the respective projections and the width and length of the block for this to be achievable.

[0034] As was previously stated, this matching would also be matched by appropriate cavity shapes within an underneath side of a block.

[0035] In preference, each projection projects above an otherwise generally planar shape of the face and has a shape in cross section which will allow for compatibility with an underneath cavity shape, whether that cavity shape is positioned with the respective block aligned or at right angles to the projection.

[0036] While in some cases, this would then allow for projections that might be of a square cross section or other shapes that are symmetrical about an axis to allow for this, in preference, the cross sectional shape is chosen to be circular and therefore each projection in preference is of a frusto-conical shape in one case or part of a sphere in another.

[0037] In preference, the conical shape is chosen so that in a practical sense, when one block is located over another, an edge of an upper block can be first rested on the top of the underlying block and the top block can be lowered pivotally on its resting end so that any cavity then will receive into itself the projection without snaring an edge and perhaps breaking off a portion of the projection.

[0038] This acceptable manner addresses an issue where if for instance, each projection had vertical sides, then an upper block may have to be lowered parallel so as not to interfere or break the sides of either the cavity or the projection and this is physically much more demanding and in many ways unnecessary.

[0039] Accordingly the sides of the projection and the matching shape of the cavity includes the inclined sides.

[0040] In practice, by having an outer face of the block of the wet cast cement, this can be chosen to be of either low or negligible porosity, and can be very strong and accurately sized in a way that such accuracy can be maintained through the curing process for subsequent reliance then when on a building.

[0041] Nonetheless, it is found that there is advantage in providing a small clearance between the projecting projections and the matching cavities so that a small degree of adjustment when being laid on a bed of adhesive can be of assistance.

[0042] Such tolerance is a practical consideration and any discussion in this document in relation to accuracy is intended to incorporate any tolerances that are practical in the circumstances.

[0043] With a block having an all up weight of 14 kg, a tolerance allowance of perhaps 1 or 2 mm in adjustment either from side to side or along its length has been found to be acceptable and provide that fine accurate finessing that is available if further accuracy is required in the vertical alignment of a wall.

[0044] While we have described a block, we have also realised that in manufacture of such a block, it is of advantage to provide that the block is made by having a mould in which the wet cast cement-based material providing the outer material of the block is held during a curing process.

[0045] Such a mould can be aligned so that it is in one sense vertical so that facing sides are formed while being held in a vertical alignment.

[0046] In another arrangement, a block can be formed by having one side face lower most and then the mould is first coated with a wet cement and then either as a preformed core or otherwise, a material of lighter density is located so as to be within a core area of the block to be formed and then a final coating of wet cast cement-based material over a back of the core which can then either be rough finished or fine finished either during or subsequent to a curing at least of the wet cast cement-based material.

[0047] In a further form there is a method of manufacture which is to locate a preformed core of lighter material within a mold, then introducing in a fluid form wet cast concrete so that it is to flow to fill the mold including being around the core, and then allowing the wet cast concrete in fluid form to set.

[0048] In another preferred case the method can include a first wet cast cement-based material being inserted into the mould as a layer across a bottom of the mould, then a mixture of an expanded plastic material with a binder of sand and cement is poured into the mould to be left then to set.

[0049] In a further preferred case the method can include a first wet cast cement-based material being inserted into the mould as a layer across a bottom of the mould, then a mixture of an expanded plastic material with a binder of sand and cement is poured into the mould, then a further wet cast cement-based material is poured on top of the mixture, with the thus resulting materials being then left to set.

[0050] The mix ratios are in preference approximately as follows although these individual ratios depend on a number of further factors so that some experimentation is needed in practise both in relation to the quantities and also the source of

the commodity items such as plastersizer. The aim is to get a wet mixture that allows for a reasonable distribution of the lighter polystyrene beads

Cement	4.8 kg
Fine beach sand	5.6 kg
3 mm polystyrene expanded beads (@20 kg = 1 m3)	7.2 litres
Plastersizer	120 ml
Super-plastersizer	12 ml
Accelerant	40 ml
Water	1.12 lts

[0051] One of the advantages of the arrangement described is that by having a wet cast cement-based material with its appropriate strength and its ability to present a finished face which has been formed by close association of the casting materials with a finished surface of the mould, that subsequent treatment of the block may no longer be necessary.

[0052] This however, is not to say that we do not incorporate at least in the broader sense of this invention other materials that may be of advantage, for instance, an inclusion of a ceramic tile on an outer face during the casting process.

[0053] In a further form the invention can be said to reside in a building block of cast concrete which is substantively of rectangular proportions having thereby two sides, two ends and a top and bottom where the two sides are parallel to each other and oppositely positioned one with respect to the other, the two ends are parallel to each other and oppositely positioned one with respect to the other, and the top and bottom are oppositely positioned one with respect to the other and each have a planar surface which is parallel one with respect to the other and being further characterised in that there are a plurality of equally spaced apart protrusions each being located approximately midway between respective sides of the block and extending above the planar surface of the top and a plurality of equally spaced apart receiving cavities extending into the planar surface of the bottom each cavity corresponding in spacing apart so as to receive a one protrusion extending into a bottom surface and where the respective protrusions and apertures are in respectively mutually corresponding positions.

[0054] In further preference it may be further characterised in that the wet cast concrete includes polystyrene foam particles.

[0055] In further preference it may be further characterised in that the protrusions are orthogonally symmetrical with respect to the block.

[0056] In further preference it may be further characterised in that the cast concrete is a lightweight concrete by having a core that is of a less dense than a remainder of the block.

[0057] In further preference it may be further characterised in that the wet cast concrete is a concrete with particulate foamed plastics integrated there through.

[0058] The invention may also apply to a construction in which a first block as characterised anywhere hitherto is positioned on a second block as characterised anywhere hitherto and the first said block having upwardly directed protrusions engaging within corresponding cavities within an underneath face of the second said block.

[0059] In a further form the invention can reside in a block as above where the protrusions are of pyramidal shape.

[0060] In a further form the invention can be said to reside in a building block comprised of at least in the main by weight cement, and having a core of lighter material than the material of a remainder of the block.

[0061] In a further form the invention can be said to reside in a building block comprised of at least in the main by weight cement, and having a core of lighter material than the material of a remainder of the block, the core being a mixture of expanded plastics and a binder.

[0062] In a further form the invention can be said to reside in a building element including a body with three sets of opposedly positioned sides defining thereby a generally rectangular shape, the body having a core of a first material and a second different material from said first material surrounding the core material providing thereby an at least substantially continuous outer surface of said second material, and a one side of a one of the set of opposing sides having at least one protrusion extending outwardly from a planar surface of the side and at least one cavity in the further opposed side of the same set of opposed sides in a position and of a size to receive and effect an alignment of a further block having the same shape and size of this first defined block by receiving a or the protrusions into the cavity or cavities.

[0063] In a further form the invention can be said to reside in the above where the second material is more dense than the first material.

[0064] In a further form the invention can be said to reside in the above wherein the second material is made from a mix comprising cement, sand and water.

[0065] In a further form the invention can be said to reside in the above wherein the first material is made from a mix including cement, sand, water and polystyrene.

[0066] In a further form the invention can be said to reside in the above wherein the protrusion is of frusto conical shape with a wider portion closer to a main body of the element.

[0067] In a further form the invention can be said to reside in a the above where the block is a composite and wherein the engagement means includes at least one male portion on a first surface, and at least one female portion in a second surface opposing said first surface, wherein in use a female portion is adapted to accept a male portion for the purpose of joining and causing to be aligned two building blocks.

[0068] In a further form the invention can be said to reside in a building block being a body with three sets of oppositely positioned sides a planar shape or a planar base shape each planar shape or planar base shape aligned to be at right angle to each of the other shapes defining thereby a generally rectangular shape, the body having an inner core of a first material and an outer portion of a second material which is of a different density to the said first material providing thereby an at least substantially continuous outer surface of said second material surrounding the said first material.

[0069] In a further form the invention can be said to reside in a building block being a body with three sets of oppositely positioned sides each being of a planar shape or a planar base shape each planar shape or planar base shape aligned to be at right angle to each of the other shapes defining thereby a generally rectangular shape, the body having an inner core of a first material and an outer portion of a second material which is of a different density to the said first material providing thereby an at least substantially continuous outer surface of said second material surrounding the said first material, a one side of a one of the set of opposing sides having at least one protrusion extending outwardly from a planar sur-

face of the side and at least one cavity in the opposite side of the same set of opposed sides in a position and of a size to receive and effect an alignment of a further block having the same shape and size of protrusion and cavity as this first defined block and adapted thereby to receive a or the protrusions into the cavity or cavities.

[0070] In preference the protrusions are positioned so that they are spaced apart central axis to central axis along a longer length of the block by a distance which is the same as the width face to face substantially of the block.

[0071] Also each protrusion at an end of a block is a distance away from the end face of the block by a distance which to an axis of the protrusion is one half the distance of the width face to face substantially of the block.

[0072] This allows for each block to be positioned with an interlocking engagement at right angles to the elongate direction of an underlying block. In a further form the invention can be said to reside in an assembly of two blocks each of which is characterised as elsewhere herein and where the dimensions and shape of a first of the blocks are substantially identical to the dimensions and shape of a second of the blocks where the first of the blocks is positioned above and aligned to have a front and rear face of each define for each a common plane and where the first block with its bottom face is resting on, directly aligned and adhering by a thin adhesive interface extending at least substantially between the two mating faces.

BRIEF DESCRIPTION OF THE DRAWINGS

[0073] For a better understanding of this invention, it will now be described in relation to embodiments which shall be described with the assistance of drawings wherein:

[0074] FIG. **1** is a perspective view from above and one side of a block according to a first embodiment,

[0075] FIG. **2** is a perspective view of the same block as in FIG. **1** viewed from a side,

[0076] FIG. **3** is a perspective view of the same block as in FIGS. **1** and **2** being the first embodiment where there is a part cutaway to show an outer facing coat and an inner core, and it also shows the arrangement of projections from a top face and cavities into a lower face,

[0077] FIG. **4** is a cross-sectional view of two blocks placed one upon the other in an interlocking relationship and joined in this case by an adhesive between inter-engaging faces, the two blocks being shown being the same as the block shown in the preceding FIGS. **1-3**,

[0078] FIG. **5** is a plan view of the first embodiment as shown in the previous figures,

[0079] FIG. **6** is a side elevation of the same block as in the previous figures with a part cutaway across a bottom portion,

[0080] FIG. **7** is a side elevation of the same block as in the preceding drawings and according to the first embodiment and a left hand corner at the bottom being shown in part cutaway and the cavities being shown in dotted outline.

[0081] FIG. **8** is a side elevation of a plurality of blocks placed in an appropriate interlocking position with, however, the lower layer of blocks being located on a mortar bed which is positioned on the upper face of a supporting foundation,

[0082] FIG. **9** illustrates the way in which an upper block is positioned and able to be manipulated so that one corner can be located first, the block lowered pivotally about that support without necessarily damaging vulnerable edges of cavities or projections,

[0083] FIG. **10** shows the position resulting from the actions as shown in FIG. **9**,

[0084] FIG. **11** illustrates an assembly showing a first course of blocks positioned on a mortar bed foundation with a second overlapping across two blocks where a first of the blocks is at right angles forming a corner,

[0085] FIG. **12** is a further illustration of the way in which a block can be manipulated and lowered onto a set of blocks beneath the upper block without damage to either cavity or projections,

[0086] FIG. **13** illustrates a mould to be used in the manufacture of blocks according to a further embodiment,

[0087] FIG. **14** is an enlarged view of a portion of the view as in FIG. **13**, except that there is now shown a coating of cement to provide a wet cast outer surface to a block,

[0088] FIG. **15** shows the mould as in FIGS. **13** and **14** which have now been pivoted to bring to the two sides together and the mould has been firstly coated with wet cast cement-based material and filled with a lighter cement and there is a top to the mould also coated with wet cast cement-based material to be inserted into the top of the material in the mould,

[0089] FIG. **16** is an exploded view of parts including the die that where there is now a preformed core, spaces to keep the preformed core centrally positioned, and such that there can be a space between the preformed core and the mould in which wet cast concrete can be poured and appropriately vibrated as appropriate.

[0090] FIG. **17** is a larger block from which preformed cores can be cut,

[0091] FIG. **18** is a perspective view of a further die where the block is to be cast on the flat and where a first coating of wet cast cement-based material is placed over a lowermost face and a remainder of the material is then poured over this and fills the die with a back surface being floated,

[0092] FIG. **19** is an exploded view of the parts providing the assembly of FIG. **18**.

[0093] FIG. **20**, **21** and **22** are perspective views of a further embodiment where the block is a masonry composite with uppermost protrusions and lowermost cavities being correspondingly shaped and positioned and being in each case of a shape which is semi spherical.

BEST MODE FOR CARRYING OUT THE INVENTION

[0094] It is of advantage to establish that the purpose of the invention is to change significantly the way in which masonry walls or walls of this general type might be constructed.

[0095] It has hitherto been conventional to use a mortar bed which on the one hand allows for significant change and adjustment and alignment of an individual block once positioned on the bed but at the same time requires an expertise and skill firstly to place the mortar bed in position, and also to keep it supplied to a bricklayer and then to ensure that each brick or block as the case might be is then adjusted so as to be firstly aligned to the vertical, aligned to the horizontal, and such that at least one outer face is aligned with adjacent faces so as to provide a generally planar surface or at least a surface which has changes according to a desired pattern.

[0096] Such a strategy has a number of difficulties which have been implicit within the building industry for many years.

[0097] A first of these is that there is a finite time before a mortar bed will set so that the height a particular wall can be constructed to is limited when underneath beds have been not been fully cured.

[0098] Further, the constructional strength of a wall depends upon the weight of individual members resting on others and only to some extent the physically weak bond that might occur between a mortar bed and the brick or block that is positioned on it.

[0099] There have been increasing difficulties in many cases where skilled bricklayers are either in short supply or necessarily require higher rewards for conducting the quite strenuous and challenging work.

[0100] Referring now to the first embodiment, the block **1** has upper **2** and lower **3** surfaces which include a plurality of protrusions for extending from an otherwise generally planar surface **2** and a plurality of cavities **5** inset from the surface **3**.

[0101] The arrangement of the protrusions **4** in relation to the surface **2** and the arrangement of the cavities **5** in relation to surface **3** are such that the protrusions **4** will generally locate within and generally therefore interlock with the consistently aligned and placed cavities with respect to the protrusions.

[0102] Each protrusion is of a common shape and dimension and in this case is of frusto-conical shape with the wider base of the frusto-cone lowermost in line with the otherwise planar surface of the surface **2** and the top of the frusto-cone shown for instance at **6** is co-annular with the lower diameter **7** and such that the angular relationship of the side wall shown for instance at **8** is approximately 45° to the horizontal or vertical.

[0103] The distance between the axis of each adjacent frusto-cone protrusion **4** shown typically at **9** is the same distance as the width between the broader faces **11** and **12**, this width being shown at **10**.

[0104] Further, each protrusion has its axis so that it is equally distant between the respective faces **11** and **12** and the axis at each end is a distance from the end which is one half of the width of the block.

[0105] The cavities **5** having a frusto-conical shape generally matching that of the protrusions **4** nonetheless have the dimensions in which a one of the protrusions will protrude into a one of the cavities **5** and with a clearance of only a small amount, for instance, perhaps 1 or 2 millimetres typically, one will interlock therefore and inter-engage with the other to maintain a block above having these same characteristics with a block below.

[0106] The cavities **5** mirror the relationships as described in relation to the protrusions **4**. To this extent then they have each a central axis passing vertically through each of these and each of these axes is separated from an adjacent axis by the width **10** of the block.

[0107] Further, the end cavity, for instance at **14**, has its axis at, within the tolerances acceptable within the building industry, one half the width **10** of the block away from the end **15**.

[0108] Further, within each cavity, there is a sidewall **16** which is at 45° to its central axis and a top of the respective cavity is a circular area half the diameter of the lower circular area coincident with the surface **3**.

[0109] The block in general is of rectangular shape in this case and has each of the respective oppositely positioned surfaces at parallel alignments and at right angles one with respect to the other.

[0110] For such a construction method to be useful, respective alignments of interlocking blocks will depend upon accuracy of the interconnecting faces so that instead of a mortar bed which will have a thickness of perhaps one or two centimetres, it is expected that this will now provide for, if desired, a connection to be made using an adhesive or glue where the separation between the respective mating faces is very small indeed and might be typically one or two millimetres.

[0111] By having a wet cast outer finish, it makes for closer tolerance and facilitates a more accurate wall using this interlocking assembly system.

[0112] A next factor however, is that one of the advantages of such a system is that each block can be placed into position very quickly and of course, many blocks can be placed one upon the other quite quickly because the time required to allow for a sufficient adhesion between facing surfaces is not so critical because additional weight on top of one another will not of itself significantly harm the adhesion between the surfaces even when the adhesion is still uncured.

[0113] Nonetheless, there is advantage in having as big a block in physical size as is reasonably feasible, given the reasonably requirement of low cost, and in general terms, it is considered that a maximum comfortable weight for a bricklayer might be 14 kg.

[0114] In order for a block of this type to have a width and have the comparative length as shown, there is significant advantage in providing a material which is less dense than wet cast cement based material. It is known to have aerated cement but one of the difficulties with aerated cement is that it is still quite difficult to get a significant reduction in density or at least maintain an aerated state and maintain some reasonable distribution of the aeration.

[0115] According to this first embodiment, the block **1** includes a core **20** which in this case is made from styrene foam mixed with wet castable cement.

[0116] A mixture that has been found to be useful is as follows.

Cement (portland cement)	4.8 kg
Fine Sydney beach sand	5.6 kg
3 mm polystyrene expanded beads (@20 kg = 1 m3)	7.2 litres
Plastersizer	120 ml
Super-plastersizer	12 ml
Glenium 51 from Degussa construction chemicals in Sydney Australia is one example of a super plastersizer	
Accelerant (calcium chloride)	40 ml
Water	1.12 lts (this can be increased to 2 or more litres in a typical example)

[0117] These ratios have been found to require some experimentation especially the quantity of water which can be increased until there is sufficient mobility in the mixture and the choice and quantity of other components especially the plastersizer which is available as a commodity from various suppliers. The aim is to get a wet mixture that will permit the integration of the polystyrene into the mix and effect some modest distribution of the polystyrene beads through the mix so that the lighter density core can then be formed and set within the outer surrounding.

[0118] Such a core material can be either directly poured into a mould or it can be preformed with subsequently an outer facing fully surrounding the block or it can in another

case be faced only on one side with a dense wet cast cement based material. The term "cement" is used throughout to describe a material that is or has similar properties to portland cement but can include where the context permits to also include the case where the "raw cement" includes a sand or like extender.

[0119] While a block **1** has been shown with a line of six protrusions and six matching cavities, various other modular sizes can also be made and also there can be some blocks which are appropriate to include so that one side extends along one side of a wall, and another part extends along another side of a wall in which the two respective walls are at right angles, one to the other.

[0120] Such a corner block then is another alternative.

[0121] However, there will be as in this first embodiment, a main block the general dimensions of which are as follows, namely width, height, length, height of each protrusion from base to peak, angle of side of each protrusion, difference in diameter between the cavity and protrusion in each case, all up weight of the block, where this is fully encased with an outer wet cast cement-based material.

[0122] FIG. **4** shows in a typical cross-sectional view how two blocks will be expected to sit one on the other and each having an expanded polystyrene foam core and an all round wet cast facing.

[0123] FIG. **8** shows specifically the way in which the blocks may in the first instance be located on a foundation which doesn't have appropriately positioned protrusions. In this case, the blocks can be located on a mortar bed and will require some skill in order to set these up accurately and aligned.

[0124] This first course however, once laid, then provides the basis for the rest of the blocks to be positioned relatively straightforwardly and quickly and with much less skill required.

[0125] It is a factor in relation to a slight tolerance between the protrusions and the cavities that there will still be a small tolerance which even when filled with an adhesive appropriate for the purpose, will allow a slight adjustment by the person constructing the wall.

[0126] Referring to FIGS. **9** and **10**, the difficulty that is being considered here is that if one has a relatively heavy block that is to be located one upon the other, then if for instance the cavity and the protrusion each had parallel sides with very little tolerance, it would be appropriate to then position the top block fairly accurately above the lower one and then lower these once relatively accurate alignment had been established.

[0127] It is considered that this could be quite awkward and make potential for breaking off edges significant with the resultant problem being that the hardened material once broken off will reside between the mating surfaces and interfere with an accurate fit.

[0128] By having sloping edges however, one approach that is convenient is to lower a block by first grounding one end and then simply rotating the block down as shown in FIG. **9**.

[0129] It has been established that this will reduce significantly any accidental breaking off of parts with interfering then between respective mating surfaces.

[0130] FIG. **11** is a further illustration of the way in which a first course can be positioned on a foundation where in this case the mortar base fills the cavities.

[0131] Also, there is an end block **30** so that a full block **31** in this case overlaps also entirely the underneath block **32**.

[0132] This however, would not be the normally desired arrangement and it would be an in-filled block of appropriate length so that there would be the more normal overlapping alignment as is shown in FIG. **12**.

[0133] In FIG. **13**, there is a die **40** which is made from two parts, **41** and **42**, which are joined together by a central hinge so that they can be hinged together into a shape that is shown at **15**. The point of these dies being separate however, is that this allows for a coating of wet cast cement-based material which is made from in this case a mixture of portland cement and sand and the mixture is then to be liberally coated over the respective surfaces.

[0134] Prior to this step, a release agent is spread over the mould.

[0135] The thin layer **43** of the wet cast cement-based material is coated throughout the die and in this case also is extended although not specifically shown as such into the shapes at **44**.

[0136] Once fully coated, the two halves **40** ad **41** are brought together and a mixture of polystyrene foam and Portland cement and sand together with plastersizers and accelerants as previously described are mixed together and once mixed are poured as shown in FIG. **15**.

[0137] Some care needs to be taken to attempt to get an uniform distribution of the polystyrene foam and it can be of assistance to use well-known binder plastersizer agents for this purpose.

[0138] Once filled, a cap **45** which is also coated with wet cast cement-based material and **46** is placed into the top of the mould at **47** and then the whole of this is then left to let the wet cast cement-based material generally cure.

[0139] Although this provides an arrangement that can provide a product according to the embodiment it has one or two difficulties that are now being addressed.

[0140] The first of these is that the polystyrene foam may have a tendency to separate from the wet cast cement-based material if the whole is subjected to vibration for instance.

[0141] The use of vibration is conventional in such applications in order to consolidate the wet cast cement based material and to remove pockets of air.

[0142] One approach to reduce this difficulty has been to preform a core in which the precast polystyrene material which is individual pellets or shredded particles of polystyrene bound together by a portland cement with extender mixture has been preformed and then appropriate cores have been cut from such a preformed batch.

[0143] In such a case then, as is shown in FIG. **16** the preformed core **50** is positioned and kept separate from the outer walls by appropriate spacers such as at **51**, **52**, **53** and **54** and then otherwise, the mould as described in the earlier FIGS. **13**, **14** and **15** is used.

[0144] In FIG. **17**, this illustrates the batch method of moulding a core and then cutting material from this.

[0145] A further embodiment however, includes a mould **60** as shown in FIGS. **18** and **19** which is intended to be adjustably held in position with a clamp **61** which includes clamping hold-down bolts **62** and a hold-down frame **63**.

[0146] The sides of the surround defining the mould which is now an open top mould includes opposite sides **64** and **65** with appropriate shapes to define the cavities, for instance at **66** and protrusions at **67**.

[0147] The arrangement here is that the first coat on the floor **68** is a coating of thickness perhaps of between 1 and 2

centimetres depth fully across the floor and thereafter simply the wet precured mixture of wet cast cement-based material and polystyrene.

[0148] The polystyrene material in this case then, will define the outer thinner edges of the block thus formed and the back of the block in this case will not be defined by a mould as such but can be floated in conventional manner or it can have a rough finish which can if needed be ground to a smoother facing finish afterwards.

[0149] It is implicit in this technique that the mould is used so that the block itself is on its flat and removal of the mould is by individual pieces being able to be released from the sides.

[0150] Referring now to FIGS. **20**, **21** and **22** these show perspective views of a further embodiment where the block is a masonry composite with uppermost protrusions and lowermost cavities being correspondingly shaped and positioned and being in each case of a shape which is semi spherical.

[0151] The block **70** is of rectangular proportions with a chamfer edge **71** along an upper edge of a side **72**.

[0152] The protrusions **73** are each of semi spherical shape and are located at spaced apart locations which are equidistant from each plane defined by a side **72** and side **74**. Further the spacing is also arranged that when a like block is positioned end to end with the said first block then the protrusion **75** at a first end of the first block will be approximately the spacing distance from a protrusion at an adjacent end of the second block. This allows for overlapping with an interlocking alignment to be achieved.

[0153] The cavities **76** are each of a corresponding in size and semi spherical shape to the protrusions extending from the oppositely positioned top of the block **70**, extending through the otherwise planar bottom of the block **70** and are correspondingly positioned so that each is spaced to be equidistant from a planar alignment defined by the respective sides **72** and **74** and are also each an equal distance apart one from the other except that they are approximately one half this distance from a plane defined by an end of the block **70**.

[0154] The block as previously described is a composite masonry block where there is an outer facing **77** of a higher density material to provide a harder and tougher facing with an inner core material **78** of lesser density. This allows for a larger block for given overall sizes where there may be a weight restraint established by occupational lifting restrictions.

[0155] The inner core material is an extended material provided by a mixture of expanded plastics material particles, and a binder in this case a cement chosen in this case to be portland cement, and sand. It is a difficulty that using a light material such as expanded polystyrene is made easier if a superplastisizer is also used which assists in mixing.

[0156] In use the block shown in this further embodiment is able to be manufactured as in any of the earlier described methods and will enable blocks of similar shape, size and configuration to be joined by an adhesive so that they can be closely conforming in position and by having the tougher outer face have a better face

[0157] While we have referred to expanded polystyrene as-one material in this application, it is not intended at least in the broadest sense of this invention that it should be limited to this.

[0158] While a description has been given of protrusions and cavities, and these have been shown with a circular cross-section in plan, there could be in a broader sense some variations from such circularity and even a square shape would be possible although less preferred provided that a cavity would fit over such a protrusion equally well from one alignment of an elongate direction of the block to an alignment at right angles of an elongate direction of a further block to this.

1-39. (canceled)

40. A composite masonry building block comprising an outer facing material of wet cast cement material that substantially surrounds a core comprising expanded plastic particles and a binder, so that the core material is of lower density than the outer facing material.

41. The building block as in claim **40**, further characterised in that the wet cast cement-based material is a mixture of an extender and a binder.

42. The building block as in claim **40**, further characterised in that the wet cast cement-based material is a mixture of an extender being sand, and a binder being Portland cement.

43. The building block as claim **40**, further characterised in that the core binder is a wet cast cement-based material.

44. The block as in claim **40**, further characterised in that the core is comprised of, at least in the main by volume, expanded polystyrene foam particles and a binder selected from a material or materials which are compatible both with expanded polystyrene foam and the outer wet cast material.

45. The building block as in claim **40**, further characterised in that the block is of rectangular proportions in outer peripheral shape, where there are two opposite faces providing an outer face and an inner face, two end faces and a top and bottom face.

46. The building block as in claim **45**, further characterised in that these respective faces are all orthogonally aligned one with respect to the other so that it is a rectangular block.

47. The building block as in claim **45**, further characterised in that there are further provided one or more projections in a one of the faces of the block and one more cavities corresponding in being a matching shape, size and position relative to the matching shapes in the opposed face within a second oppositely positioned face of the block.

48. The building block as in claim **47**, further characterised in that there are a plurality of projections on an upper face that are spaced apart an equal distance such that these projections can be used by matching cavities in a further block of the same size and shape as the first block, which is either aligned by having its direction of elongation at right angles to a direction of elongation of the first block or which overlaps the first block only by a proportion of the total length of the block.

49. The building block as in claim **48**, further characterised in that each projection projects above an otherwise generally planar shape of the face, and has a shape in cross section which will allow for compatibility with an underneath cavity shape, whether that cavity shape is positioned with the respective block aligned or at right angles to the projection.

50. The building block as in claim **49**, further characterised in that the shape of each protrusion in plan at its base is of a circular cross sectional shape.

51. The building block as in claim **50**, further characterised in that the cross sectional shape in plan of each respective protrusion is circular in cross section at its base.

52. The building block as in claims **50**, further characterised in that the shape of each protrusion is frusto-conical.

53. The building block as in claim **52**, further characterised in that the sides of the protrusion and the matching shape of the cavity has inclined sides.

54. The building block as in claim **48**, further characterised in that there is a clearance between the protrusions and matching cavities of a further block so that a small degree of adjustment in relative position is allowed.

55. A method of manufacture of a composite masonry building block as in claim **40**, characterised by the steps of having one side face lower most, coating at least some parts of the mould with a wet cement and then either as a preformed core or a mixture of a density that when set will be lighter than the set density of outer face material, locating a material of lighter density to be within a core area of the block to be formed and then effecting a final coating of wet cast cement-based material over a back of the core which can then either be rough finished or fine finished either during or subsequent to a curing at least of the wet cast cement-based material.

56. The method as in claim **55**, further characterised in that there are the further steps which include a first wet cast cement-based material being inserted into the mould as a layer across a bottom of the mould, then a mixture of an expanded plastic material with a binder of sand and cement being poured into the mould to be left then to set.

57. The method as in claim **56**, further characterised in that there is a further step where wet cast cement-based material is poured on top of the mixture, with the thus resulting materials being then left to set.

58. The method as in claim **55** to a method of manufacture, further characterized in that mix ratios for the material of lighter density is substantially as follows:

a.	Cement	4.8 kg
b.	Fine sand	5.6 kg
c.	3 mm polystyrene expanded beads (@20 kg = 1 m3)	7.2 lts
d.	Super-plastersizer	120 ml
e.	Accelerant	40 ml
e.	Water	1.12 lts

59. A masonry building block which is substantively of rectangular proportions having thereby two sides, two ends and a top and bottom where the two sides are parallel to each other and oppositely positioned one with respect to the other, the two ends are parallel to each other and oppositely positioned one with respect to the other, and the top and bottom are oppositely positioned one with respect to the other and each have a planar surface which is parallel one with respect to the other and being further characterised in that there are a plurality of spaced apart protrusions each protrusion being located approximately midway between respective alignments of planes defined by the respective sides of the block and extending above a generally planar surface of the top and a plurality of equally spaced apart receiving cavities extending into a generally planar surface of the bottom, each cavity corresponding in spacing apart so as to correspond in relative positions size and shape to the respective protrusions and adapted to receive a one protrusion extending into a bottom surface and where the respective protrusions and apertures are in respectively mutually corresponding positions, wherein the block has an outer facing material that substantially surrounds a core made from expanded plastic particles and a binder, so as to be of lower density than the outer facing material.

60. The building block as in claim **59**, further characterised in that the core material comprises wet cast concrete and polystyrene foam beads or particles.

61. The building block as in claim **59**, further characterised in that the protrusions are orthogonally symmetrical with respect to the block.

62. The building block as in claim **59**, further characterised in that the wet cast concrete is a concrete with particulate foamed plastics integrated there through.

63. A construction in which a first building block as characterised in claim **40** directed to a block is positioned on a second block also as characterised in claim **40** directed to a block, and the first block having upwardly directed protrusions, these protrusions engaging within corresponding cavities within an underneath face of the second block.

64. A composite masonry building block comprised of at least in the main, by weight, cement, and having an inner core of lighter material than the material of a remainder of the block, which is substantially surrounding the inner core, the core being a mixture of expanded plastics particles and a binder.

65. A building block including a body with three sets of opposedly positioned sides defining thereby a generally rectangular shape, the body having a core made from expanded plastic particles and a binder, and a second denser material surrounding the core material providing thereby an at least substantially continuous outer surface of said second material, and a one side of a one of the set of opposing sides having at least one protrusion extending outwardly from a planar surface of the side and at least one cavity in the further opposed side of the same set of opposed sides in a position and of a size to receive and effect an alignment of a further block having the same shape and size of this first defined block by receiving a. or the protrusions into the cavity or cavities.

66. The building block as in preceding claim **65**, further characterised in that the second material is denser than the first material.

67. The building block as in claim **65**, further characterised in that second material is made from a mix comprising at least cement, sand and water.

68. The building block as in claim **65**, further characterised in that the first material is made from a mix including cement, sand, water and polystyrene.

69. The building block as in claim **65**, further characterised in that the protrusion is of frusto conical shape with a wider portion closer to a main body of the element.

70. A building block being a body with three sets of oppositely positioned sides each being of a planar shape or a planar base shape, each planar shape or planar base shape aligned to be at right angle to each of the other shapes defining thereby a generally rectangular shape, the body having an inner core made from expanded plastic particles and a binder, and an outer portion of a second material which is of a different density to the said first material providing thereby an at least substantially continuous outer surface of said second material surrounding the said first material, a one side of a one of the set of opposing sides having at least one protrusion extending outwardly from a planar surface of the side, and at least one cavity in the opposite side of the same set of opposed sides in a position and of a size to receive and effect an alignment of a further block having the same shape and size of protrusion and cavity as this first defined block, and adapted thereby to receive a or the protrusions into the cavity or cavities.

71. The building block as in claim **70**, further characterised in that the protrusions are positioned so that they are spaced

apart central axis to central axis along a longer length of the block by a distance, which is the same as the width face to face substantially of the block.

72. The building block as in claim **70**, further characterised in that each protrusion at an end of a block is a distance away from the end face of the block by a distance which to an axis of the protrusion is one half the distance of the width face to face substantially of the block.

73. An assembly of two blocks each of which is characterised as in claim **40**, where the dimensions and shape of a first of the blocks are substantially identical to the dimensions and shape of a second of the blocks, where the first of the blocks is positioned above and aligned to have a front and rear face of each define a common plane and where the first block with its bottom face is resting on, directly aligned and adhering by a thin adhesive interface extending at least substantially between the two mating faces of the respective blocks.

* * * * *