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(54) **Construction block.**

(57) A block for use in construction, particularly though not exclusively paving, has top and bottom surfaces one of which is a rectangle and the other of which is a square or a rectangle. In the case where the other surface is a rectangle the block has the major axes of the rectangles mutually perpendicular and has a shape at mid-height in horizontal cross-section which is substantially a square and the length of the side of said square is within the range 66% to 300% of the height of the block. In the case where the other surface is a square, the major axis of the rectangle is greater in length than the side of the square and the said square has a side of length within the range 66% to 300% of the height of the block.

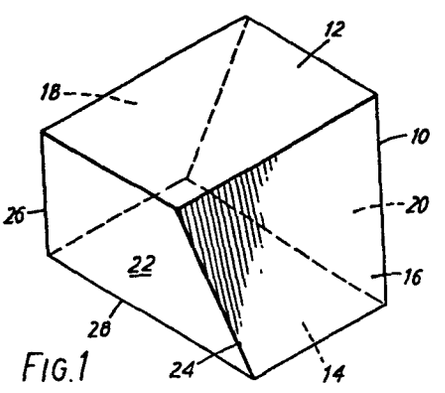

FIG.1

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CONSTRUCTION BLOCK

This invention relates to a block for indoor or outdoor use and primarily for use in paving and making roads, but which may be of use in other applications such as flooring.

There has been a proposal to form a tile with parallel upper and lower surfaces and with obliquely extending symmetrical pairs of end surfaces. Such a proposal is mentioned in British Patent No. 1326026 (LUDWIGSEN) wherein the author is probably referring to the disclosure of British Patent No. 349094 (FITTON), in particular Figures 23-27 thereof and the associated description. The FITTON proposals involve an assembly of oblong blocks in two layers, the upper layer breaking joint with the lower layer. LUDWIGSEN is principally concerned to improve the tightness of joints between the paving elements and for this purpose proposes a block of which the upper portion is at least one third of the height of the block and is straight-sided, while the remainder of the block has oblique sides. Proposals directed at self-interlocking types of floor covering are made by JENSEN in British Patent No. 431605, and proposals relating to wall tiles which may be secured by concealed fitting elements are made by BURDON-COOPER in British Patent No. 551400. None of these proposals relate to a block which is easily laid by unskilled personnel, which at the same time has a high load bearing capacity, and which is not difficult to make. The block disclosed herein is particularly useful for paving. In designing paving slabs or blocks, the cost of the slabs or blocks themselves is of lesser importance than the price per unit area of the laid paving. In other words, a block which is cheap to make but expensive to lay is unattractive. Moreover, low maintenance cost for laid paving is an important factor.

According to the invention in its broadest aspect, there is provided a block for use in construction which has top and bottom surfaces one of

which is a rectangle and the other of which is either a square or a rectangle, the block in the case where the other surface is a rectangle having the major axes of the rectangles mutually perpendicular and having a shape at mid-height in horizontal cross-section which is substantially a square and the length of the side of said square being within the range 66% to 300% of the height of the block and in the case where the other surface is a square, the major axis of the rectangle being greater in length than the side of the square and the said square having a side of length within the range 66% to 300% of the height of the block.

Also according to the present invention, there is provided a block for use in construction which has top and bottom surfaces which are parallel and identical rectangles, the major axes of these rectangles being at right angles to one another and, as seen in plan, intersecting at their mid-points, the block being characterised in that its shape at mid-height in horizontal cross section is substantially a square and that the length of the side of said square is within the range 66% to 300% of the height of the block.

When the length of the side of said square is above 300% of the block height the load-bearing capacity of the block is significantly reduced and the block is of little practical use as a constructional block because it approaches the rather flat configuration of a surfacing tile. On the other hand, when the side of said square is less than 66% of the block height, the block has a rather tall and narrow configuration and is inefficient in the sense that a relatively large number of blocks are necessary to cover any given area.

According to one advantageous embodiment of the version of the invention wherein one of the top and bottom surfaces is a square, the length of the side of the square is approximately twice the height of the block. In a version of this embodiment of the invention, the top surface is square and the height of the block is from 40 to 100% of the length of the side of the square.

A constructional block in accordance with another preferred version of the invention has a rectangular top surface joined to a rectangular bottom surface by four surfaces of which one pair converge upwardly and one pair diverge, i.e. converge downwardly. The respective angles of convergence and divergence are preferably equal. Assuming that the top and bottom surfaces of such a preferred constructional block are horizontal, then each converging or diverging surface as the case may be should most preferably be at an angle of substantially 14^{o} to the vertical. This angle may lie within the range of 9^{o} to 19^{o}, or, more preferably, in the range 11^{o} to 17^{o}.

In one particular but non-limiting embodiment of the invention, the block has a first or top rectangular surface from each of whose parallel shorter edges extends an end surface disposed at an angle of from about 71 to 81^{o} to the first surface, and from each of whose parallel longer edges extends a side surface at an angle of from about 99 to 109^{o} to the first surface, the side and the end surfaces terminating at the edges of a second or bottom rectangular surface of the block. All of the said surfaces are substantially planar. In a particular (but non-limiting) example,the end surfaces are located at substantially 76^{o} to the top surface and the side surfaces are located at substantially 104^{o} to the top surface.

The block is preferably (but of course not necessarily) of a size that may conveniently be held in one hand; this means that it can be laid extremely easily and rapidly. For example the height of the block may be from about $2\frac{1}{2}$ to $4\frac{1}{2}$ inches (64 to 115mm). Another possibility is that the block may be of a size which can be conveniently held and lifted in two hands, that is to say its height may be about 7 to 11 inches (177 to 280 mm). The block (as another alternative within the invention) may be of a size and weight such that it has to be mechanically moved and mechanically manipulated.

As a further alternative within the invention, the blocks may be held together in panels by a gripping and lifting mechanism, and may be laid as panels by providing such a mechanism with a manipulating and laying capability. Such panels may be of any desired size and weight and in particular may be so large that they can only be lifted and laid by powered mechanical equipment. In this way, large areas can be rapidly covered with a surface having a good load-carrying capability.

In the present specification, the words 'top' and 'bottom' are used for brevity only, and without limiting effect; they are used on the assumption that a block according to the invention is at rest with one of its rectangular surfaces on a planar horizontal support. Blocks according to the invention could of course be used to pave an area to produce a sloping roadway or a cambered roadway.

While reference has been made by way of example to particular angles between the top surface and side and end surfaces, the invention is not regarded as limited to the use of any particular angle except as required by the stated relationship between the block height and the length of a side of the mid-height square, or of the square forming a top or bottom surface.

An important feature of blocks according to the invention is that they interlock on three axes and provide mutual support; also they serve to spread a load applied to one such block over adjacent blocks. They are very quickly, easily and inexpensively laid to provide a paved surface without the need to employ skilled personnel and the resulting paving has an attractive appearance. No mortar, filler or grout or other compound is required between blocks, although such compounds or materials may be used between the blocks if desired in certain applications. As the blocks mutually support each other in the event of heavy loading on one block (in other words, load is transferred to some adjacent blocks) a substrate may be employed which is less elaborate and less expensive to lay than in the case of prior art non-interlocking paving blocks.

In a preferred embodiment of the invention wherein the top and bottom surfaces are rectangles, the length of the side of the said square at mid-height is from 70% to 250% of the height of the block; in a more preferred embodiment of the invention it is from 75% to 200% of the said height; and it a yet more preferred embodiment it is from 80% to 150% of the said height.

All or some of the edges of the blocks may be rounded off or bevelled if desired, to avoid sharp edges which might be chipped in handling. Bevelling on the top surface edges of the blocks is often desirable as it minimises the effect of uneven laying of the blocks.

The invention will be better understood from the following description of non-limiting examples, given with reference to the accompanying drawings in which:-

Figure 1 is an isometric view of one example of a construction block according to the invention;

Figure 2 is a plan view of the block shown in Figure 1;

Figure 3 is an elevation of the block shown in Figure 1;

Figure 4 is an elevation , seen at 90^{o} to the view of Figure 3, of the block shown in Figure 1;

Figure 5 is an isometric view showing several blocks according to the invention laid to form a paved surface.

Figure 6 is a top plan view of an alternative embodiment of a construction block according to the invention;

Figure 7 is a front elevation of the block shown in Figure 6;

Figure 8 is a side elevation of the block shown in Figure 6;

Figure 9 is a perspective view of the block shown in Figure 6; and

Figure 10 is an isometric view of a further embodiment.

The block 10 for use in paving or construction shown in Figures 1-4 has first, second, third, fourth, fifth and sixth surfaces, 12, 14, 16, 18. 20 and 22 respectively. The block is usually solid and may be cast or

moulded from any suitable material. For example it could be cast from concrete or formed from a ceramic material or a clay-based material. It could be moulded, extruded or formed from a synthetic plastics material or even from a soft metal. For certain applications, however, the block could be hollow. For convenience of description herein, the surface 12 will be called the top surface, 14 the bottom surface, the surfaces 16 and 18 will be called side surfaces, and the surfaces 20 and 22 will be called end surfaces. The end surfaces 20 and 22 are each at an angle less than 90° to the top surface 12 and at an angle greater than 90° to the bottom surface 14. The edges 24, 26 each make the same angle with the edge 28 of the surface 22, and the surface 20 is of identical shape to the surface 22. The side surfaces 16 and 18 each make the same angle greater than 90° with the top surface 12 and make its complement with the bottom surface 14. The surfaces 16 and 18 are of identical shape to each other and (except for inversion) to the surfaces 20 and 22.

For certain applications, the side and/or end surfaces of the block may be domed or ribbed or beaded or made undulating in form; in other words, these sides may depart slightly from planar. Any or all of the surfaces of the block may be roughened or scored or covered with an anti-slip surfacing, for example made of grit or sand embedded in a spreadable or sprayable material such as a synthetic plastics resin. The blocks may be coated, for example, with bitumen, resin polymers, or sand, in a suitable adhesive carrier.

As another embodiment of the invention, a block may have a raised or depressed portion on its top surface, that is, the top surface may be mostly or partly planar but with a bump or upward projection or a depression therein. Such a projection or depression may be smoothly rounded, or pointed, and may be conical, or pyramidal, or tetrahedral. The purpose of such a projection is to make the resulting paved surface non-planar.

Blocks in accordance with the invention may be made in any desired size, according to the intended use, but a convenient practical size for general purpose paving use is for the rectangles 12 and 14 each to be about 5 inches by about 3 inches, i.e. about 125mm by about 80mm, and to be separated by a perpendicular distance of about 90mm (3½ inches).

Figure 5 shows a paved area made up from paving blocks according to the invention simply laid upon a substrate (not shown). It will be seen that each block is surrounded by four blocks whose rectangular top surfaces have their major axes all parallel and all at right angles to the major axis of the rectangular top surface of the block which they surround. The inclined side and end surfaces both locate and interlock the blocks and allow transfer of load. For example if block E is heavily loaded its end surfaces transfer some load to the blocks D and F. Likewise if the block C is heavily loaded then its inclined end surfaces (one shown at C1) transfer load to the two adjacent blocks, part of this load being received by an end surface B1 of the block B. Recesses (e.g. T1, T2, T3), each the shape of an inverted pyramid, are defined by an array of blocks according to the invention, and these recesses will normally be too small to be of any concern to a highway engineer. Alternatively, if desired, they may be deliberately filled with earth and grass-seeded or filled with hard or hardening filler.

The block 40 shown in Figures 6-9 has a geometrical shape which is substantially equivalent to the bottom half of the block shown in Figures 1-4. The block 40 has a square top surface 42, a rectangular bottom surface 44 parallel to the surface 42, a pair of identical but oppositely sloping side surfaces 46, and a pair of oppositely sloping end surfaces 48 which are also identical with each other. The side surfaces 46 may be at an angle in the range 9^{o} to 19^{o}, and preferably 14^{o} or 15^{o} to the vertical when the block is positioned with the surfaces 42 and 44 horizontal. The end surfaces 48 are preferably at the same angle to the vertical when the block is similarly positioned. The height of the block may be from 40 to 100%, for example from about 45 to about 60%, and more preferably about half of the length of a side of the square surface 44. The length (major

axis) of the rectangular surface 44 is preferably slightly more than, and the width (minor axis) thereof is preferably slightly less than the length of a side of the square surface 42. This form of block has the advantage that the exposed surface of the paving is smooth and continuous, that is to say it does not have any of the recesses T1, T2 (Figure 5) which occur when using a block according to the embodiment of the invention shown in Figures 1-4.

Figure 10 illustrates a further embodiment of construction block according to the invention. The block illustrated in Figure 10 has a planar rectangular top surface 60, a rectangular planar bottom surface (not referenced) whose major axis is of substantially perpendicular to the major axis of the top surface 60, a pair of (inwardly) sloping side surfaces (one shown at 62) and a pair of (outwardly) sloping end surfaces, one shown at 64. The surface 62 is located at an angle of substantially 76°, e.g. 75° to 77° to the plane of the surface 60. The surface 64 is located at an angle of substantially 104°, e.g. 103° to 105° to the plane of the surface 60. Around the periphery of the surface 60, there are four planar bevelled surfaces, two shown at 66 and 68, the bevel angle being substantially 45° to the plane of the surface 60. Alternatively the four edges of the surface 60 could be radiused. Other bevelled angles could be used. The purpose of such bevelling or radiusing is to avoid sharp edges which could be dangerous or which could be chipped or damaged in handling.

The surfaces 64 (and its counterpart outwardly sloping surface, not referenced) has a pair of ribs 70, 72 thereon. These ribs 70, 72 each extend downwardly from just below the junction of the bevel surface 68 and the sloping surface 64 to the lower edge of the surface 64. Each rib is of rectangular shape in cross-section, this shape being chosen for ease of manufacture, but it is not essential that the ribs should have a rectangular cross-sectional shape. For example, a rib of part-circular, e.g. hemispherical, cross-sectional shape could alternatively be employed. While the surface 64 and its counterpart each have two ribs as shown, a

different number of ribs could be employed if desired. The ribs serve to space adjacent blocks from each other, permitting particulate material such as sand or dust to be placed in (or to accumlate in) the interstices, to constitute a cushioning spacer material. The rib height (that is, the extent to which it stands proud of its supporting surface) may be from about 3 to 7mm, preferably 5mm. It is preferred that the width of each rib should be from about 5 to 10% of the length of the shorter of the top or bottom side of the surface upon which the rib is located, and each rib advantageously may be located a distance from the end of the said shorter side which is from about 8 to 14% of the length of the said shorter side. That is to say, the dimensions a, b, c, d, e, x and h are preferably related to each other as follows:-

a is from 5 to 10% of x
d is from 5 to 10% of x
b is from 8 to 14% of x
c is preferably about 62% of x
e is from 11 to 16% of h.

The ribs 70 and 72 are preferably parallel to each other and perpendicular to the edge 74 but alternatively they could be inclined at a small angle to the said perpendicular.

Ribs are only required on two opposite sides of the block because each block when laid is at right angles to its four neighbours, as most clearly seen from Figure 5. Consequently if the array shown in Figure 5 was made up from blocks in accordance with Figure 10, the ribs on the surface B1 of block B would engage block C and ribs on the side surface of block E which is partly visible in the recesses T1 and T2 would engage the non-visible end of block B. A similar relative arrangement of ribbed and non-ribbed side surfaces exists throughout the array. In the laying of a paved area, the ribs on the block being laid are brought into contact with the adjacent block, leading to the result that the blocks are necessarily correctly and evenly spaced from one another.

It is a feature of the Figures 1-4 embodiment of this invention that paving or other structures made up of interlocking blocks can be constructed from blocks all of substantially identical shape. In the case of a block according to the invention where the top and bottom surfaces are equal rectangles, such blocks can be used either way up, since the rectangular surface 12 on each block is identical in shape to the rectangular surface 14 thereon and the blocks have the same shape each way up.

In contrast to certain prior proposals, substantial areas of paving can be laid using only one kind of block and all the blocks are substantially identical. A wedge-shaped block may be provided for use at the edge of a paved area so as to provide a vertical surface which can be butted up against a substantially flat vertical or retaining member. Alternatively edge blocks can be cut to fit in a conventional manner.

An area of paving, once laid and with edges firmly supported, is extremely durable and in most practical embodiments will require little or no maintenance. Blocks according to the invention are particularly useful in making temporary paving e.g. on muddy building sites, and can be taken up and re-used elsewhere, providing the blocks at the edge of a paved area are taken up first. With a paved area made from those blocks according to the invention which have rectangular top and bottom surfaces, the blocks interlock with each other with surface-to-surface contact and the shape of the blocks is such that individual blocks or a group of adjacent blocks cannot be pushed down relative to surrounding blocks, nor can blocks be taken up starting from the centre. This increases the durability of the paved area and tends to reduce maintenance costs and the cost of the substrate upon which the blocks are laid. When the blocks are being laid, the juxtaposition of two already-laid adjacent blocks provides a location shoulder at the junction of the square matrix grid which is notionally defined in the mid-height plane of the blocks. These location shoulders serve to accurately locate a subsequently-laid block, without the need to set up any guiding or marker arrangements. The invention as

particularly described herein permits roads to be laid without expensive plant on site and with relatively unskilled labour, and so is useful in underdeveloped or developing areas of the world.

While the foregoing description relates mainly to "dry" paving wherein the blocks are laid without intervening filler, this is not an essential feature of the invention. For example, in certain applications the blocks could be laid with intervening filler. The filler could be bitumen or resin polymers, or sand, or pulverised fly ash, for example.

The invention also extends to paving and other structures, in particular sloping surfaces and retaining surfaces, made up from blocks according to the present invention, as well as to the individual blocks, no matter how they are made or constructed. For example, in certain applications, blocks according to the invention may be formed in situ, e.g. by pouring concrete into a mould of suitable shape defined by formwork which can be later removed, if desired.

CLAIMS

1. A block for use in construction which has top and bottom surfaces one of which is a rectangle and the other of which is a square or a rectangle, the block in the case where the other surface is a rectangle having the major axes of the rectangles mutually perpendicular and having a shape at mid-height in horizontal cross-section which is substantially a square and the length of the side of said square being within the range 66% to 300% of the height of the block and in the case where the other surface is a square, the major axis of the rectangle being greater in length than the side of the square and the said square having a side of length within the range 66% to 300% of the height of the block.

2. A block for use in construction which has top and bottom surfaces which are parallel and substantially identical rectangles, the major axes of these rectangles being at right angles to one another and, as seen in plan, intersecting at their mid-points, the block being characterised in that its shape at mid-height in horizontal cross-section is substantially a square and that the length of the side of said square is within the range 66% to 300% of the height of the block.

3. A block according to Claim 1 or 2 wherein one of the top and bottom surfaces is a square, and wherein the length of the side of the square is substantially twice the height of the block.

4. A block in accordance with Claim 1 or 2 comprising a rectangular top surface joined to a rectangular bottom surface by four surfaces of which one pair converge upwardly and one pair diverge, i.e. converge downwardly, and in which the respective angles of convergence and divergence are equal and are such that in a block whose top surface is horizontal, each side surface is located at an angle in the range 13^{o} to 16^{o} to the vertical.

5. A block according to any preceding claim which is of a size that can conveniently be held in one hand.

6. A block according to any one of Claims 1-4 which is of a size which can be conveniently held and lifted in two hands.

7. A block according to any preceding claim in which one or more of its edges is bevelled or radiused.

8. A block according to Claim 7 in which the periphery of the top surface is bevelled or radiused.

9. A block according to any preceding claim in which an opposed pair of side surfaces have projecting ribs thereon.

10. A block according to Claim 3 wherein the top surface is a square and the height of the block is from 40 to 100% of the length of the side of the said square.

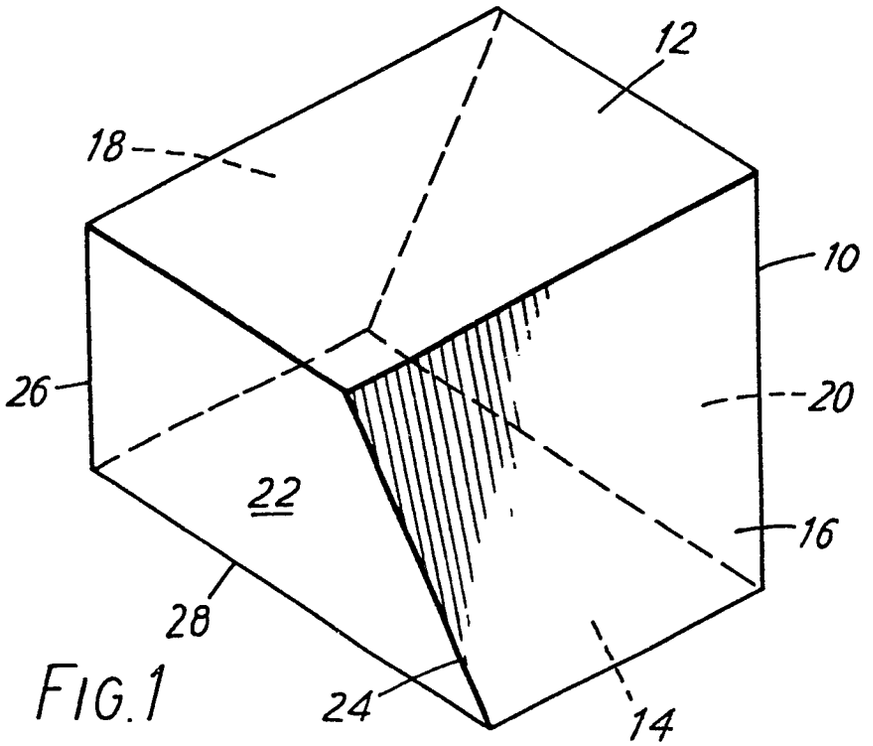

FIG.1

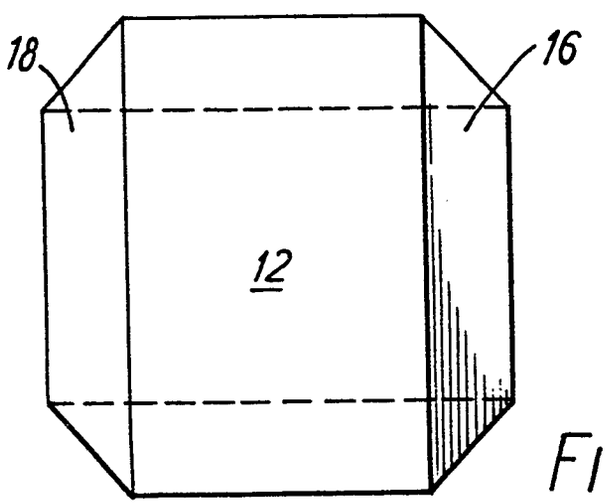

FIG.2

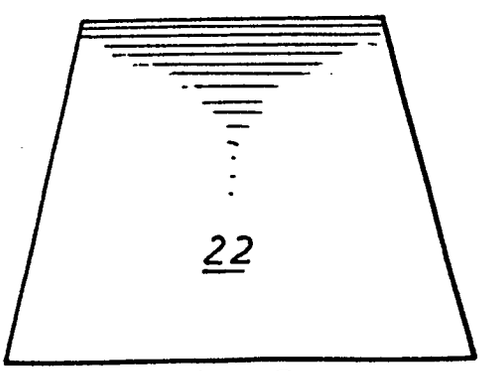

FIG.3

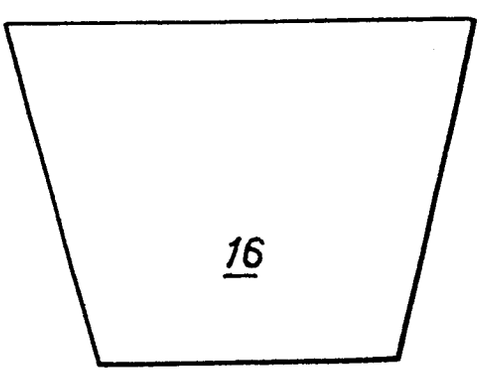

FIG.4

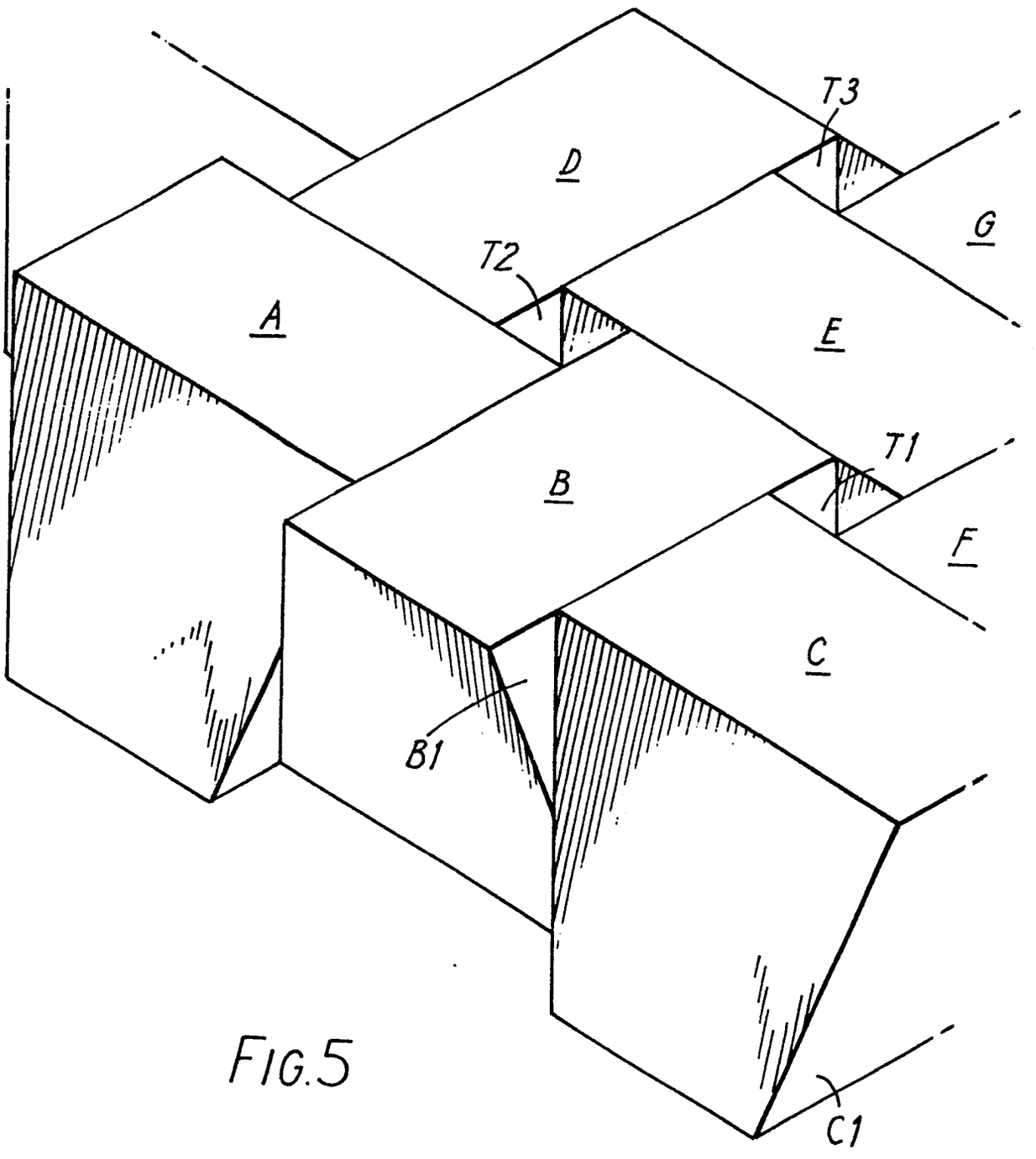

FIG.5

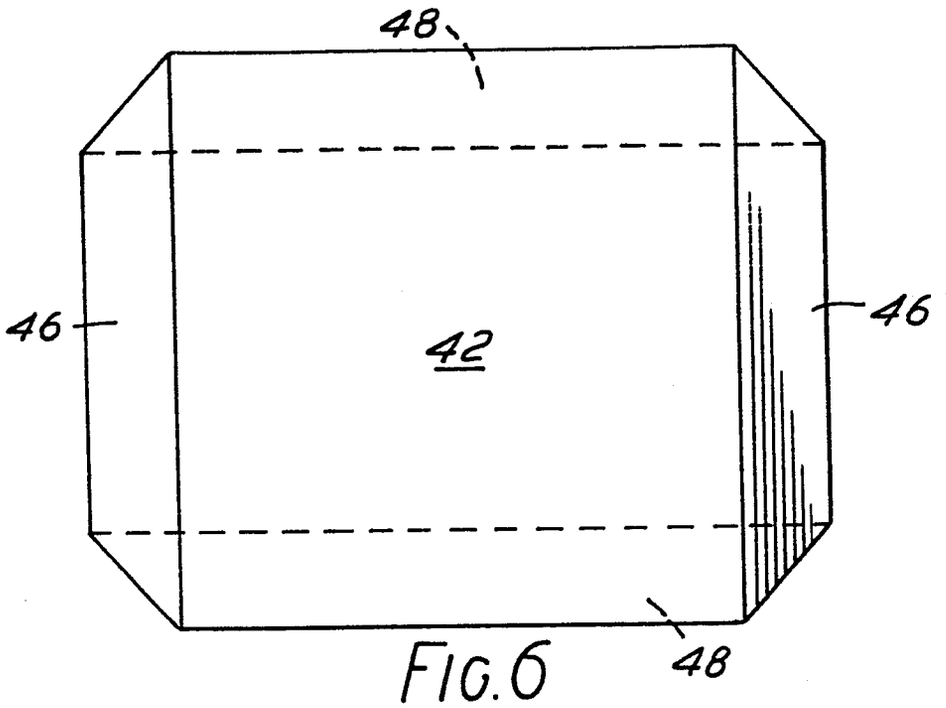

FIG. 6

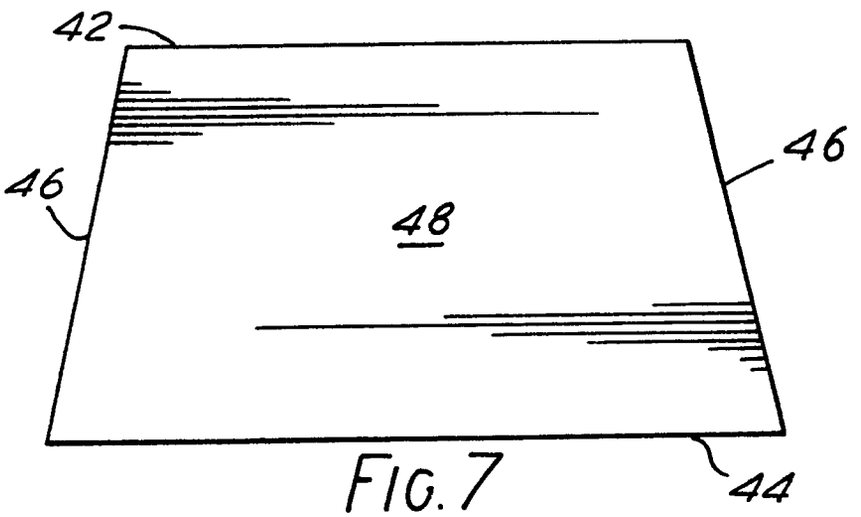

FIG. 7

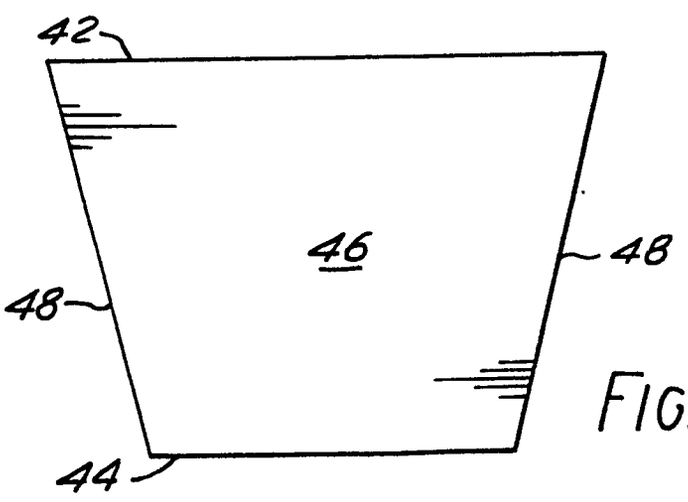

FIG. 8

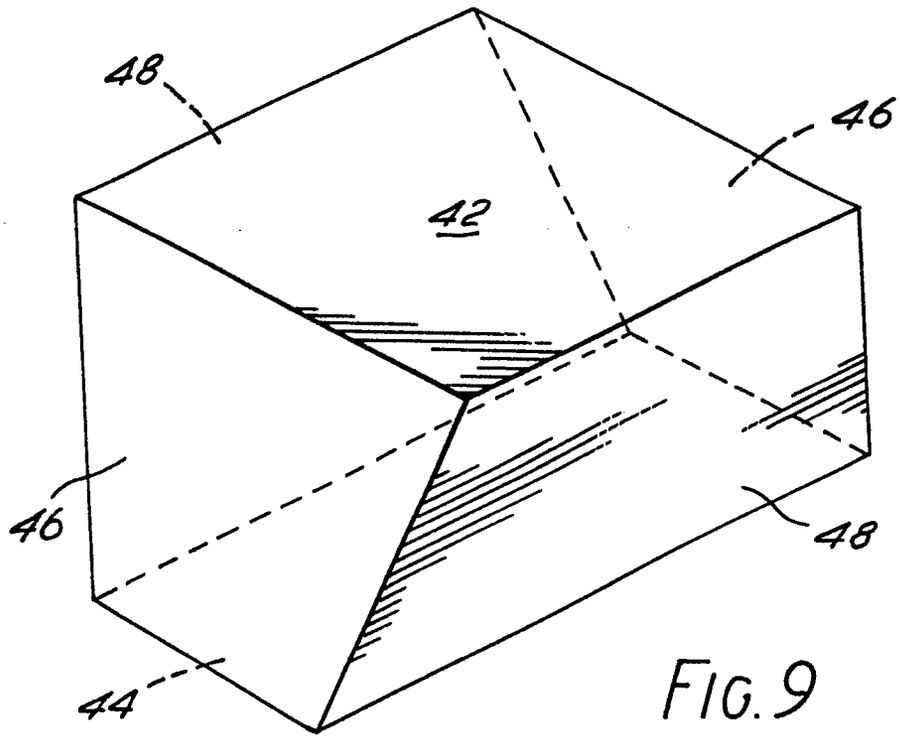

FIG. 9

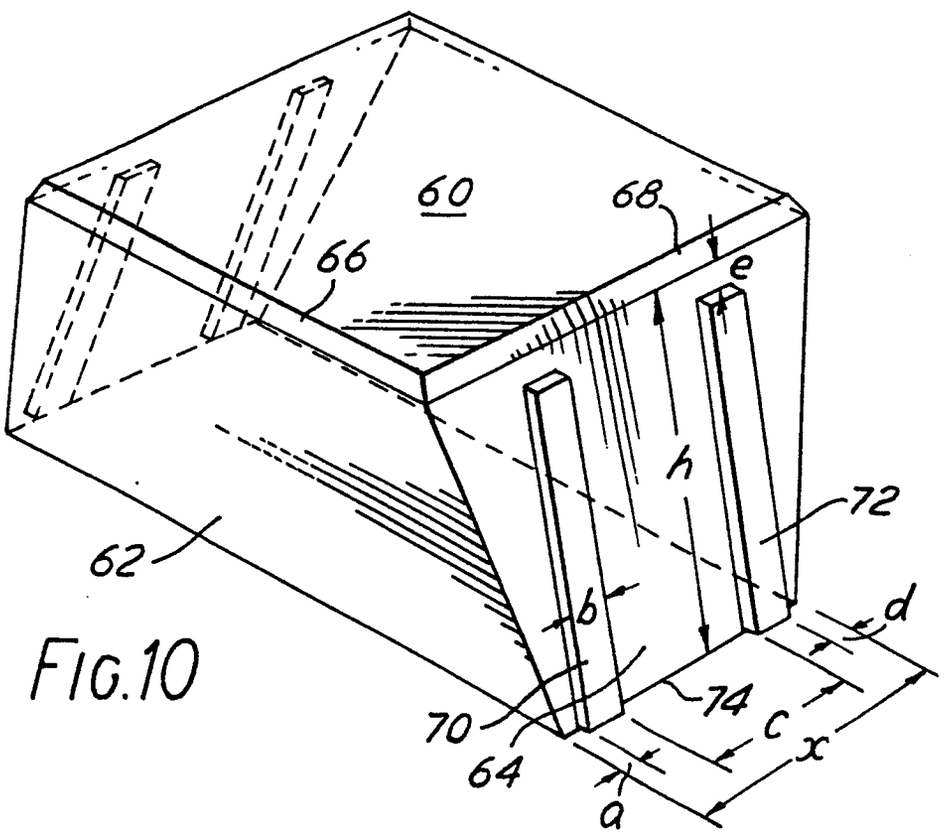

FIG. 10