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Dawn

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[54] **BLOCKS HAVING SOCKETS AND PROJECTIONS WITH INTERFERENCE FIT**

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Related U.S. Application Data

[63] Continuation of Ser. No. 208,700, Dec. 16, 1971, abandoned.

[52] **U.S. Cl.** ..... **46/25;** 35/31 G; 264/237; 273/DIG. 10

[51] **Int. Cl.²** **A63H 33/08**

[58] **Field of Search** ..... 46/25, 26; 35/30, 31 G, 35/69

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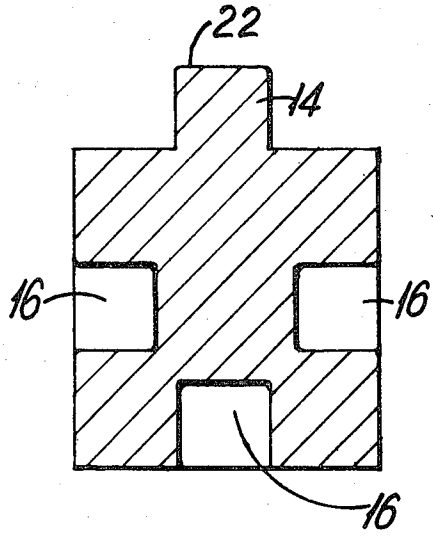
[57] **ABSTRACT**

The invention relates to a building brick for use as an educational aid, a display device or in a constructional kit for children. The brick is in the form of a solid cube having one place face, a spigot or projection of rectangular cross-section on another face, the remaining faces each incorporating a socket to accept the projection or spigot of another similar brick, the projection or spigot and socket being so shaped that an interference fit is formed when two similar bricks are joined. By making the brick of unit dimension and unit weight it can be used in constructions of bricks, inter alia, to teach the concept of weight, length, volume and so on. It is made by a process comprising injection moulding the blocks from a stiffly resilient material in a die having substantially minimum draft necessary to facilitate withdrawal, maintaining the die at a temperature below 40°F, ejecting the block from the mould when the block has cooled sufficiently to form a rigid skin and further cooling the ejected block in a bath of cold water.

5 Claims, 6 Drawing Figures



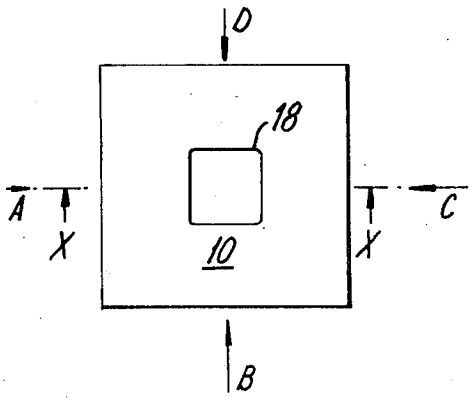


Fig. 1

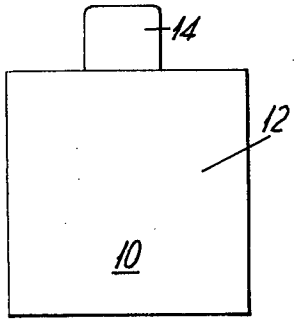


Fig. 2

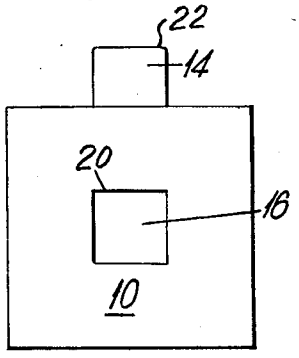


Fig. 3

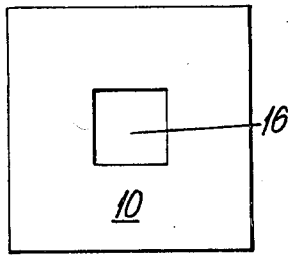


Fig. 4

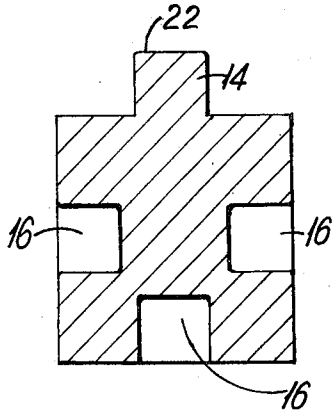
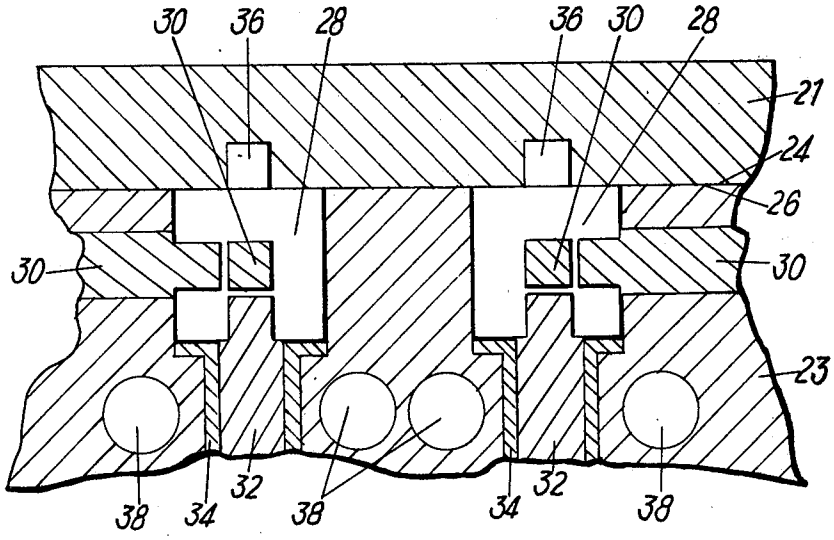


Fig. 5

Fig. 6



BLOCKS HAVING SOCKETS AND PROJECTIONS WITH INTERFERENCE FIT

This is a continuation of application Ser. No. 208,700, filed Dec. 16, 1971 now abandoned.

This invention relates to eductional aids, display devices and constructional toys for children. More particularly this invention relates to building brick units which may be joined and held together by a spigot and socket joint and to methods of making such bricks.

The use of building bricks as an educational aid has been known for a long time, so have many types of building toys. The present invention aims to combine the advantages of simplicity, versatility and structural stability in a building brick and introduces a spigot and socket joint arrangement with especially valuable characteristics whereby a number of similar bricks or units may be used as a building toy for complex shapes and as an aid in teaching, inter alia, reading, counting, geometry or topology and so on, the purposes being limited only by the ingenuity of the user.

According to the invention a building brick or unit is in the form of a solid cube having one plane face, a spigot or projection of rectangular cross-section on another face, the remaining faces each incorporating a socket to accept the projection or spigot of another similar brick, the projection or spigot and socket being so shaped that an interference fit is formed when two similar bricks are joined.

An interference fit is best achieved by small variations in the dimensions of the sockets and spigots, whereby the spigot of one brick will catch behind the edges of the socket of another brick after elastic strain has occurred during insertion of the spigot into the socket. Such dimensional variations can be produced by an injection moulding technique as described below.

Preferably the edges of the spigot which extend perpendicular to the face from which the spigot projects are radiused thereby providing a passage for the escape of air displaced from the scoket by the insertion of the spigot of another similar brick. The corners of the socket may also be radiused provided, of course, that the radii are smaller than those on the corresponding spigot.

It is often advantageous for the edges of the socket and spigot parallel to their respective faces to be radiused, for example to 0.23 mm, to reduce the tendency of the one to tear the other if insertion of the spigot of one brick into a socket of another similar brick is attempted without perfect alignment. Such imperfect alignment may often be the case when bricks according to the invention are used by young children.

In another preferred embodiment the brick is in the form of a cube with a side length of a specific length, for example 1 centimetre, to provide an association between the length of one or more bricks adjoined linearly and a standard unit of length. Thus by combining bricks one can teach the concept of length, area or volume.

It is often advantageous to have a brick of a standard weight, for example 1 gram, and the solid brick of the present invention facilitates this.

The plane face may be coloured or carry letters, figures or other symbols which may be painted or embossed onto one or more faces. Alternatively, where color is the primary consideration the whole brick can be of the desired colour, being made for example of a plastics material of the desired colour.

A brick according to the invention may be interlocked in many different ways with other similar bricks. This arises because the cube shape projection of one block can be fitted into any of four sides of another block, either with its plane face parallel to that of the second block, or with them at right-angles to those of the second block. In this way right-angled joints can be made between walls of the blocks.

When a number of bricks according to the invention have letters on them they can be fitted together to make words and used for crossword type games in which words extend in two directions at right-angles. Interlocking with the letters in the correct orientation can be achieved by having a letter printed on both sides of the block, the letter on one side being rotated through 90° relative to that on the other side. In similar way equations can be constructed in the teaching of arithmetic, various symbols being provided such as addition, subtraction, multiplication, division, equals signs and so on.

When a number of bricks according to the invention are coloured they can be used for making mosaics and in the teaching of simple geometry and arithmetic they can be used for explaining the concept of area, since the child can fill a shape with the interlocked squares and count them to find the area of the shape.

Preferably the brick is made of a resilient plastics material and we have found that most suitable materials are acrylonitrile butadiene styrene, Cycloac T and similar plastics.

The manufacture of satisfactory units according to the invention is not straightforward. We have found, for example, that despite provision of air escape passages the spigot tends to be ejected due to the draft or taper, necessary for moulding, in the spigot and socket. One way of overcoming this problem is to use a resilent material such as polythene and to create a large interference between the spigot and socket. Unfortunately this leads to damage of the spigot and/or socket after a very short time, lending to poor fits and ejection of the spigot.

This problem is overcome in accordance with the invention by a process comprising injection moulding the blocks from a stiffly resilient material such as acrylonitrile butadiene styrene (ABS) in a die having substantially the minimum draft necessary to facilitate withdrawal, maintaining the die at a temperature below about 40° F., ejecting the block from the mould when the block has cooled sufficiently to form a rigid skin and further cooling the ejected block in a bath of cold water.

Preferably the die is cooled by water maintained at a temperature approaching freezing.

The die is preferably formed from a hard material such as steel to B.S.S. EN30B, pre-air hardened to a hardness of about 50 Rockwell and carburized to give a surface hardness of about 60 Rockwell especially at the mating surfaces of the two die halves. In this case these parts of the die which comprise cavities are preferably formed by spark erosion.

This process has the surprising effect that the sockets tend to expand in cross section near their bottom as the block cools and solidifies. This has the further surprising effect of overcoming the problem of ejection of the spigot which we find is satisfactorily retained within the

socket without the need for too great an interference and more resilient materials.

In order that the invention may be better understood an example in accordance with it, together with a method of making a brick according to the invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a plan of a unit according to the invention;

FIG. 2 is an elevation on the arrow D of FIG. 1;

FIG. 3 is an elevation on the arrow A of FIG. 1;

FIG. 4 is an underneath plan of the unit shown in FIG. 1;

FIG. 5 is a section on the line X—X in FIG. 1; and

FIG. 6 is a schematic part cross-section of apparatus for moulding the units of FIGS. 1 to 5.

Referring to FIGS. 1 to 5 there is shown a typical unit according to the invention comprising a solid cube 10 having one plane face 12. Of the remaining faces, one has a spigot 14 of square cross-section projecting therefrom while all the others have sockets 16 of square cross-section and of such dimensions as to make the spigot 14 an interference fit therein.

The edges 18 of the spigot and the corners 20 of the sockets are radiused, the radii of the edges 18 being greater than those of the corners 20, thus leaving, when a spigot is inserted in a socket of another brick, a passage allowing for the escape of air. Edges 22 surrounding the outer opening of said socket are also radiused.

The die illustrated in FIG. 6, which shows dies suitable for carrying out the process of the invention, comprises two separable halves 21 and 23 each of which is formed from a single piece of, for example, nickel-chrome steel such as B.S.S. EN30B which is pre-air-hardened to a hardness of 48–52 Rockwell and carburized to give a surface hardness of 58–64 Rockwell especially at the mating surfaces 24 and 26 of the die halves 21 and 23 respectively.

Two cubical cavities 28 are formed by spark erosion in the lower die-half 23. Each cavity 28 has the minimum draft taper necessary to facilitate withdrawal of the moulding.

Into three sides of each cavity project retractable pins 30 (only two are shown per cavity) and into the base projects a fixed pin 32. The core-portion of each pin 28 or 30 which projects into the cavity is square in cross-section with a minimum corner radius and is formed at the end of the (round) pin by grinding.

The fixed pins 32 are each surrounded by a slideable sleeve 34. The sleeve is extendable into the cavity 28 to eject the moulding once the upper die half 21 has been removed.

The upper die half 21 is spark-eroded to provide two square section cavities 36 of such dimensions as to mould a spigot on the moulding which is a push fit into a socket formed by the square section cores of the pins 30, 32.

The die is cooled by water circulating in passages 38.

In use, hot molten or paste-like acrylonitrile butadiene styrene is injected into the closed die. (We find the Marbon Chemicals CYCOLAC grade T suitable). The water circulating in the passages 38 is kept below 40° F and preferably near freezing to cool the die sufficiently for a rigid skin to rapidly form on the moulding. The upper die half is removed, the pins 30 are withdrawn and the sleeve 34 is extended to eject the mouldings which are dropped into cold water to complete their solidification. Of course, in a production run this cold water would need to be changed from time to time to maintain it at ambient temperature.

In addition to the cubes described certain other shapes may be formed primarily for use as junction pieces between cubes. Thus, for example, a member which is square in plan but triangular in elevation finds use in connecting cubes at angles other than 90° to each other. Further, a base piece can be formed comprising a multitude of sockets capable of securing the spigots of the cubes or alternatively comprise a multitude of square spigots for engagement in a socket of a cube.

What we claim is:

1. An educational aid for teaching mathematic and scientific concepts involving weights and measures, said aid comprising a plurality of solid cubes interconnected together to define an assembled, structurally stable educational aid of desired shaped for teaching a selected scientific concept, each of said cubes having six faces and having edges of unit length, and being constructed of an injection molded, stiffly resilient plastic, a single solid unitary projection projecting centrally of one of said faces of each cube, one of said faces being completely planar on each cube, a single socket located centrally in each of the remaining cube faces, each socket including a bottom portion and an outer opening portion and being shaped and dimensioned to receive the projection of an adjacent cube, the faces of each adjacent interconnected cube being in face to face relationship, an interference fit being defined by a socket of one cube receiving a projection of an adjacent interconnected cube, said interference fit including said bottom portion of said socket being expanded relative to said outer opening portion, each said projection interconnected with another cube catching behind edges defining said opening portion of a socket of an adjacent interconnected cube for providing an interlocking plurality of said cubes which cooperate to define a structurally stable assembly of desired size, shape and weight, said projections and said sockets being square in shape and the upright edges of each projection and the upright corners of each socket having a curvature, the radius of curvature on said projection curvature being greater than the radius of curvature of said corners, said curvatures defining air passage means for the escape of air displaced from the socket by the insertion of a projection of another cube thereinto.

2. The article of claim 1 wherein both said projection and said socket are square in cross-section.

3. The article of claim 1 wherein each of said cubes is made of acrylonitrile butadiene styrene.

4. The article of claim 3 wherein each of said edges of said cubes is one centimeter.

5. The article of claim 1 wherein said sockets and projections are relatively small in size as compared to the size of said cubes.

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