(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 027 376**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **80303595.5**

(22) Date of filing: **13.10.80**

(51) Int. Cl.³: **B 28 B 7/16**
B 28 B 7/18, E 04 B 2/18

(30) Priority: **15.10.79 ZA 795486**

(43) Date of publication of application:
22.04.81 Bulletin 81/16

(84) Designated Contracting States:
DE FR GB NL

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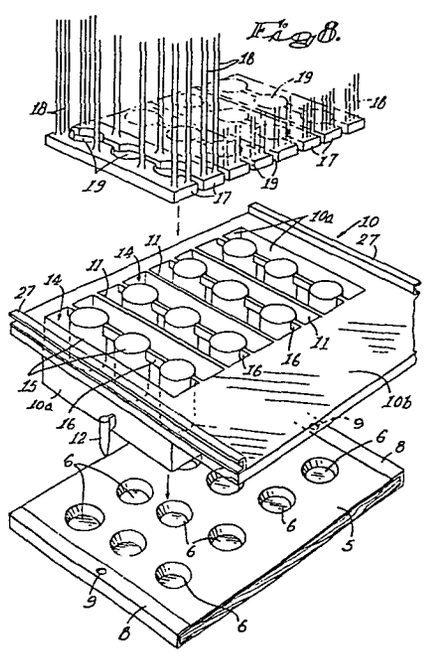
(54) **Moulding equipment for manufacturing building blocks and building block manufactured by this equipment.**

(57) Moulding equipment is disclosed for the manufacture of building blocks having male and female formations through which interlocking of blocks in adjacent courses can be effected. The moulding equipment incorporates a block forming box (10) and is characterised in the provision of a separate moulding base (5) for the box. The base (5) defines one of the formations so that when a block has been formed and the forming box (10) has been removed, the blocks can be lifted off the moulding base.



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BUILDING BLOCK MANUFACTURE

THIS invention relates to the manufacture of building blocks using moulding equipment.

An object of the invention is the provision of novel moulding equipment wherein blocks which have mating male and female keying formations may be formed in a single operation.

Such equipment comprises a moulding base, forming means receivable on the moulding base to define the sides of a building block to be formed therein, ram means for co-operation with the forming means in piston fashion for compacting a charge of material located in the forming means, and means for forming a first keying formation in the surface of the building block remote from the moulding base during formation of the building block. The invention is characterised in that the moulding base is shaped to form at the same time a second keying formation complementary to the first keying formation in the surface of the building block abutting the moulding base.

Further according to the invention the moulding base includes at least one concavity in its surface, the concavity forming the second keying formation in the building block in the nature of a male keying member.

The concavity in the moulding base may be shaped to provide a truncated conoidal second or male

keying formation. In an alternative preferred arrangement the concavity is shaped to provide the said male keying formation as a tapered annulus.

Also according to the invention the means for forming the first keying formation in the surface of the building block comprises a cylindrical element located in the forming means, the cylindrical element forming the first keying formation in the building block in the nature of a female keying member.

In the preferred arrangement the cylindrical element is adapted to provide the said first or female keying formation as a socket which extends through the building block to the second keying formation. The cylindrical element should be tapered so that in the preferred block the socket tapers towards the male keying formation which itself comprises a tapered annulus surrounding the narrow end of the socket.

Further according to the invention the equipment incorporates a plurality of cylindrical elements and concavities in the moulding base to provide a plurality of first and second keying formations in the building block during its production and a bank of forming means is provided for association with a moulding base incorporating a series of concavities such that a plurality of building blocks is formed in one operation of the moulding equipment.

Still further according to the invention the moulding base is a pallet preferably of wood and means are provided for aligning the moulding base relative to the forming means. Such aligning means may comprise a socket in the moulding base adapted to receive a locating pin mounted on the forming means.

The moulding equipment may include means to feed a pallet horizontally beneath vertically movable forming means and stop means to locate the pallet relative to the forming means, the stop means being movable to permit the pallet to be displaced past the stop means by the application of force to the pallet.

The invention also provides a moulding base having the features hereinabove described and a building block when produced by moulding equipment as described above. The invention further provides a substantially rectilinear parallelpiped building block having at least one tapered annular male keying formation projecting from a surface thereof and a complementary cylindrical female keying formation in the surface of the building block parallel to the base, the female keying formation being tapered towards and extending through the block to the male keying formation.

A preferred embodiment of the invention is described below with reference to the accompanying drawings in which:

Figures 1 to 5 are schematic diagrams showing the sequence of operation in moulding equipment according

to the invention;

Figure 6 is a cross-sectional perspective view of one form of building block according to the invention;

Figure 7 is a perspective view of stop means used in the moulding equipment;

Figure 8 is a perspective view of certain parts of the moulding equipment, associated parts being omitted for the sake of clarity;

Figure 9 is a perspective view of moulding equipment according to the invention, parts thereof being omitted for the sake of clarity;

Figures 10 and 11 are isometric X-ray views of a preferred block according to the invention seen respectively from the top and from below;

Figure 12 is a similar view from the top of a channel block according to the invention;

Figures 13 to 15 are respectively plan views of a full block according to figures 10 and 11, a half block of similar construction and a third size such block;

Figures 16 is a side view of an alternative form of the preferred block according to the invention showing the cylindrical female keying formations in the block in broken lines; and

Figure 17 is a section on the lines XV11-XV11 in figure 16.

Referring to figure 6 a rectangular parallelepiped building block 1 is provided on the base 1a thereof with three male keying formations in the form of truncated cones 2 spaced from one another along the length of the building block. In the upper surface 1(b) of the block parallel to the base 1a are three complementary female keying formations in the form of cylindrical holes 3. The holes 3 extend the greater part of the height of the building block 1 and thereby reduce the mass of the building block.

The spacing of the keying formations described above is such as to allow building blocks 1 to be laid one upon the other in staggered relationship with one or more keying formations in one block in inter-engagement with those in an adjacent block. Furthermore, the arrangement of the keying formations in the block 1 allows a junction to be established between two walls with the end keying formations in the blocks in interengagement with one another.

The moulding equipment used to manufacture the building block 1 is illustrated in figures 7, 8 and 9. A moulding base is provided in the form of a wooden pallet 5. The pallet 5 has four rows of concavities or indentations 6 therein which form the truncated cones 2 in the building blocks 1 during the moulding operation. Each side of the

pallet 5 parallel to the rows of concavities 6 is provided with a metal cladding 8 having a socket 9 extending through the pallet 5.

Forming means are provided in the form of an open ended box 10 receivable on the pallet 5. In this embodiment of the invention the box 10 has three vertical, spaced partitions 11 therein which together with the walls 10a of the box 10 form a bank of four forming boxes 14 which define the sides of four building blocks 1 formed in the box during one operation of the moulding equipment.

Each wall 10a of the box parallel to the partitions 11 is provided with an external locating pin 12 receivable in a socket 9 in the pallet 5 to align the rows of concavities in the latter with the forming boxes 14.

Means are provided in the forming boxes 14 for forming the cylindrical holes 3 in the building block 1 in its surface remote from the pallet 5 during formation of the building blocks in the forming boxes. Such means in this embodiment of the invention comprise three right circular cylindrical elements 15 positioned in each box 14 and secured by webs 16. Ram means are provided for co-operation with the boxes 14 in piston fashion for compressing a charge of material when located in the forming boxes 14 into the form of the building blocks 1. Such means in this embodiment of the invention comprise a plurality of plates 17 attached to connecting rods 18 and

having suitable apertures 19 between adjacent plates 17 to accomodate the elements 15, webs 16 and partitions 11 during the ramming operation.

The moulding equipment described above is housed in a frame 21 shown in figure 9. The frame 21 supports a hopper 22 for storing material from which the building blocks 1 are made. A receptacle 23 mounted on wheels 24 is provided to convey such material from the hopper 22 to the forming boxes 14. For this purpose the receptacle 23 is connected to suitable arms 25 adapted to be activated to displace the receptacle 23 from the position shown in figure 9 under the hopper 22 to a position over the forming boxes 14.

The wheels 24 of the receptacle 23 are mounted for movement on rails 26 on the frame 21 which align with rails 27 on the box 10 when the latter is positioned on the pallet 5.

The receptacle 23 does not have a base but is located on a flat surface 28 which is co-planar with the surface 10b of the box 10 when the latter is in position on the pallet 5.

The connecting rods 18 carrying the plates 17 are attached to a platten 30 which is provided with guides 31 receivable in a pair of guide posts 32 extending the height of the frame 21. The box 10 is similarly provided with guides 33 receivable in the guide posts 32.

A main hydraulic ram 34 is provided on the frame 21 and in a preferred form of the invention the

ram 34 operates to displace both the platten 30 carrying the connecting rods 18 and the box 10 during operation of the moulding equipment in the manner hereinafter described.

Stop means are provided on the frame 21 to locate the pallet 5 in position under the forming box 10. Such means are illustrated in figure 7 and comprise a stop member 35 projecting into the sliding path of the pallet 5. The member 35 is attached to a resiliently flexible arm 36 so that upon application of force by the pallet 5 moving in the direction of its sliding path indicated by numeral 36, the stop member 35 is displaced outwardly in the direction indicated by numeral 37 to allow the pallet 5 to pass.

The sequence of operation of the equipment will now be described with reference to figures 1 to 5 in which like numerals refer to like parts in figures 8 and 9.

The starting position of the various parts is shown in figure 1 with the receptacle 23 located under the hopper 22 where it receives material from the latter. As shown in figure 2 the pallet 5 is displaced (by a sequential pallet which will be used in the next block making cycle) to a position under the box 10 where it engages stop 35 and is initially located in position. The box 10 is then lowered onto the pallet 5 so that its locating pins 12 engage in the sockets 9 in the pallet 5 and locate the pallet accurately relative

to the forming boxes 14. The receptacle 23 containing material from the hopper 22 is then displaced on the surface 28 to a position on the box 10 where the material discharges from the receptacle 23 into the forming boxes 14.

In a preferred form, the receptacle 23 and box 10 are made to vibrate to ensure settling of the material inside the forming boxes 14.

As shown in figure 3, the receptacle 23 is then withdrawn to its starting position whereafter the platten 30 descends thrusting the plates 17 into the forming boxes 14 to compress the material therein and form the building blocks 1 therein on the pallet 5.

As shown in figure 4 the box 10 is thereupon raised to its starting position whilst the plates 17 hold the building blocks in position on the pallet 5. Thereafter, as shown in figure 5, the platten 30 carrying the plates 17 is withdrawn and the pallet 5 is displaced by an incoming clean pallet 5a to permit the process described above to be repeated.

When the building blocks on the pallet 5 have set sufficiently, they are removed and the pallet 5 is cleaned to enable it to be re-used.

The preferred building block 41 of the invention is illustrated in figures 10, 11 and 13 and is manufactured by the procedure described above. The apparatus for production of the preferred block differs from that described above only in that the cylindrical elements 15 are truncated

conical cylinders instead of right circular cylinders, the elements tapering towards the lower part of the forming boxes 14 in order to provide the tapered female keying formations 43.

In the block 41 the female keying formations in the form of conical holes 43 extend right through the block. This structure is achieved by ensuring that the elements 15 located in the forming boxes 14 extend right down to the base of the concavities 6 when the box 10 is lowered onto the pallet 5 in a block making cycle.

The result of such disposition of the conical cylindrical elements relative to the pallet is that the male keying formations 42 which are produced take the form of tapered annuli surrounding the narrow ends of the tapered sockets 43.

For the production of the preferred block 41 the forming boxes 14 are also provided with circumferential plates at their upper ends to form chamfered corners 44 on the block.

In the erection of structures with the blocks of the invention mere keying of overlapping blocks may be effected without the use of mortar or other bonding agent. To ensure that a wall structure has the necessary rigidity it may be advisable to build spaced courses in the nature of beams which will act to lock blocks of superimposed courses together.

For this purpose a block 51 is provided which has

similar male and female keying formations 52 and 53 respectively to those of the block 41 but, as will be seen from figure 12, the block 51 is of channel section.

Adjacent blocks 51 in a single course will therefore provide a continuous channel in which concrete reinforcing may be located for the formation of the beam structure.

It will be appreciated that in the construction of block 51 the forming means will, in addition to the incorporation of means for forming the female keying formations, incorporate means to form the channel in the block.

Referring now to figures 14 and 15 respectively, two-thirds and one-third size blocks 61 and 71 are provided which are otherwise identical to the preferred block 41.

The smaller blocks are useful at corners and in the building of windows and like structures.

The block 81 illustrated in figure 16 is similar to that illustrated in figure 10 except that the block of figure 16 has greater height than that of figure 10 and the female keying formations are differently shaped as described below. The larger dimensions of the block 81 is achieved by utilising suitably dimensioned forming boxes 14. The female keying formations 83 in the block 81 are formed in the block during its production by providing suitably shaped elements in the forming boxes in place of the elements 15 illustrated in

figure 8. The elements for the formation of the holes or female keying formations 83 in the block 81 comprise a right circular cylindrical portion in the upper zone of the boxes to correspond with the hole sections 83a, and a truncated conical portion to correspond with the hole sections 83b. It will be appreciated that any additional height of building block may be achieved in this way merely by varying the axial dimensions of the forming boxes 14 and right cylindrical portions of the shaped elements 15 therein.

Many embodiments of the invention may be made differing from that described above in matters of detail only and without departing from the scope of the invention as defined in the claims.

CLAIMS

1. Moulding equipment suitable for manufacturing building blocks comprising a moulding base, forming means receivable on the moulding base to define the sides of a building block to be formed therein, ram means for co-operation with the forming means in piston fashion for compacting a charge of material located in the forming means, and means for forming a first keying formation in the surface of the building block remote from the moulding base during formation of the building block, characterised in that the moulding base (5) is shaped to form at the same time a second keying formation (2) complementary to the first keying formation (3) in the surface of the building block abutting the moulding base (5).

2. Moulding equipment according to claim 1, characterised in that the moulding base (5) includes at least one concavity (6) in its surface, the concavity (6) forming the second keying formation (2) in the building block in the nature of a male keying member.

3. Moulding equipment according to claim 2, characterised in that the concavity (6) in the moulding base (5) is shaped to provide a truncated conoidal second or male keying formation (2).

4. Moulding equipment according to claim 2, characterised in that the concavity (6) in the moulding base (5) is shaped to provide

the said male keying formation (2) as a tapered annulus.

5. Moulding equipment according to any one of the preceding claims characterised in that the means for forming the first keying formation (5) in the surface of the building block comprises a cylindrical element (15) located in the forming means, the cylindrical element (15) forming the first keying formation in the building block in the nature of a female keying member (3).

6. Moulding equipment according to claim 5, characterised in that the cylindrical element (15) is adapted to provide the said first or female keying formation (3) as a socket which extends through the building block to the second keying formation (2).

7. Moulding equipment according to claim 6, characterised in that the cylindrical element (15) is tapered in the direction of the moulding base (5).

8. Moulding equipment according to claim 5, characterised in that it includes a plurality of cylindrical elements (15) in the forming means (10) and a plurality of concavities (6) in the moulding base (5) to provide a plurality of first and second keying formations in the building block.

9. Moulding equipment according to any one of the preceding claims, characterised by

a bank of forming means for association with a moulding base (5) incorporating a series of concavities (6) such that a plurality of building blocks is formed in one operation of the moulding equipment.

10. Moulding equipment according to any one of the preceding claims characterised in that the moulding base (5) is a pallet.

11. Moulding equipment according to claim 10, characterised in that the pallet is constructed of wood.

12. Moulding equipment according to any one of the preceding claims, characterised in that it includes means (9,12) for aligning the moulding base (5) relative to the forming means (10).

13. Moulding equipment according to claim 12, characterised in that the means for aligning the moulding base (5) relative to the forming means comprises a socket (9) in the moulding base (5) adapted to receive a locating pin (12) located on the forming means (10).

14. Moulding equipment according to any one of the preceding claims, characterised in that it includes means to feed a moulding base (5) horizontally beneath vertically movable forming means (10) and stop means (35, 36) adapted to locate the moulding base (5) relative to the forming means (10), the stop means being movable to permit the moulding base (5) to be displaced past the stop means by the application of force on the

moulding base.

15. A building block when produced by moulding equipment as claimed in any one of the preceding claims.

16. A rectilinear parallelepipedal building block having at least one tapered annular male keying formation projecting from a surface thereof and a complementary cylindrical female keying formation in the surface of the building block parallel to the base, characterised in that the female keying formation (3) is tapered towards and extends through the block to the male keying formation (2).

17. A moulding base suitable for use with moulding equipment comprising forming means receivable on the moulding base to define the sides of a building block to be formed therein and ram means for co-operation with the forming means in piston fashion for forming a charge of material when located in the forming means into the form of the building block, characterised in that the moulding base (5) is shaped to form a keying formation in the surface of the building block abutting the moulding base.

18. A moulding base according to claim 17, characterised by at least one concavity (6) in its surface, the concavity forming the keying formation in the building block in the nature of a male keying formation (2).

19. A moulding base according to

claim 18, characterised by a plurality of rows of concavities (6) in its surface.

20. A moulding base according to any one of claims 17 to 19, characterised in that the moulding base is a pallet.

21. The moulding base of claim 20, characterised in that the pallet is constructed of wood.

22. A moulding base according to any one of claims 17 to 21, characterised in that it includes a socket (9) in the moulding base for receiving a locating pin (12) on the forming means (10) for aligning the moulding base relative to the forming means.

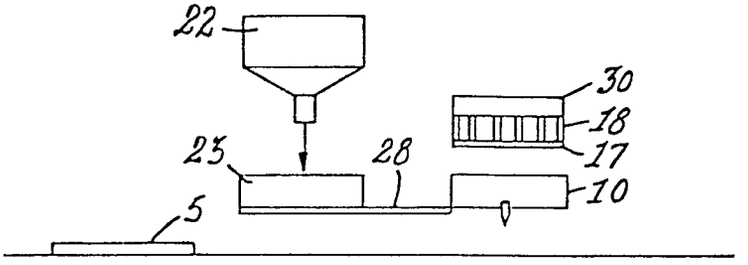


Fig 1.

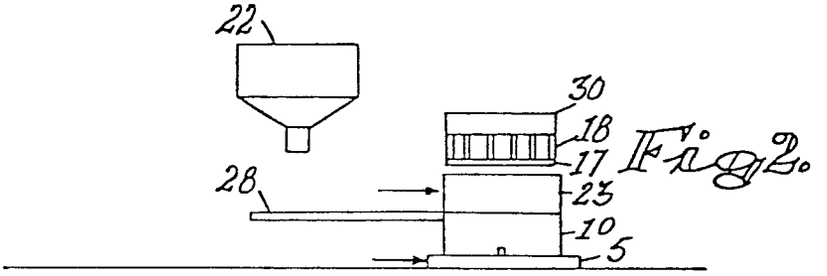


Fig 2.

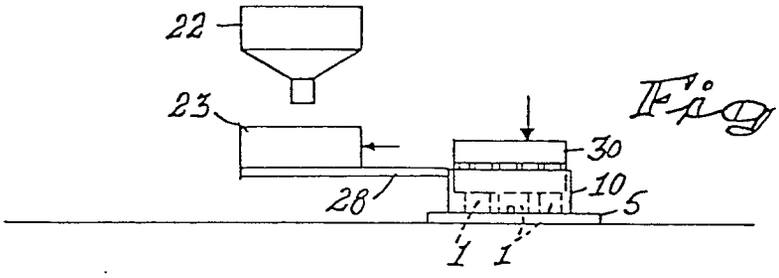


Fig 3.

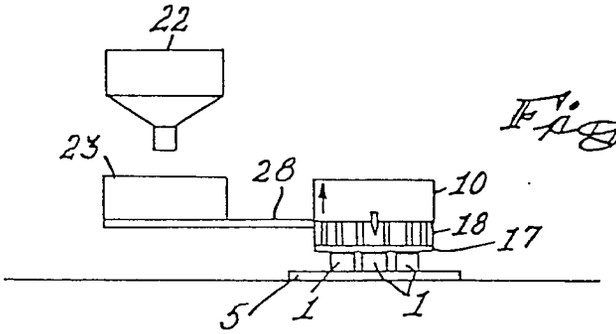


Fig 4.

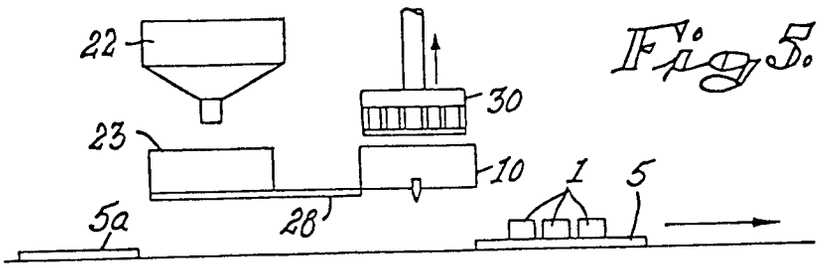
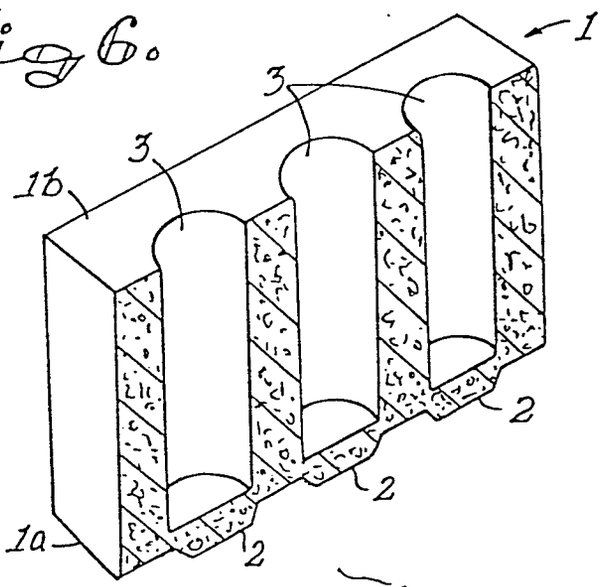


Fig 5.

Fig 6.



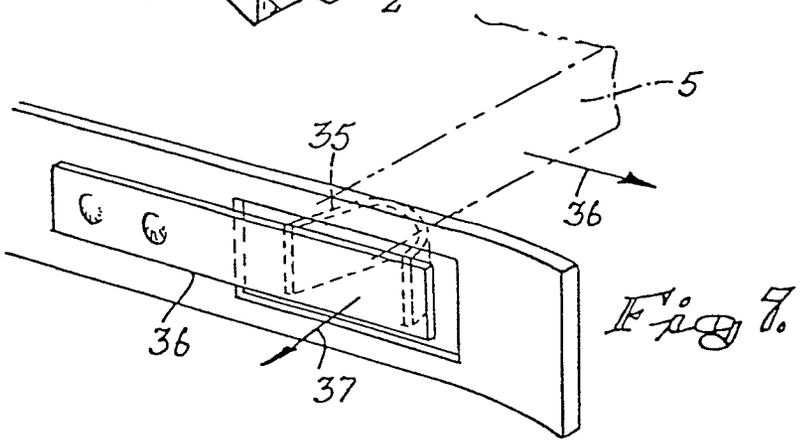


Fig 7.

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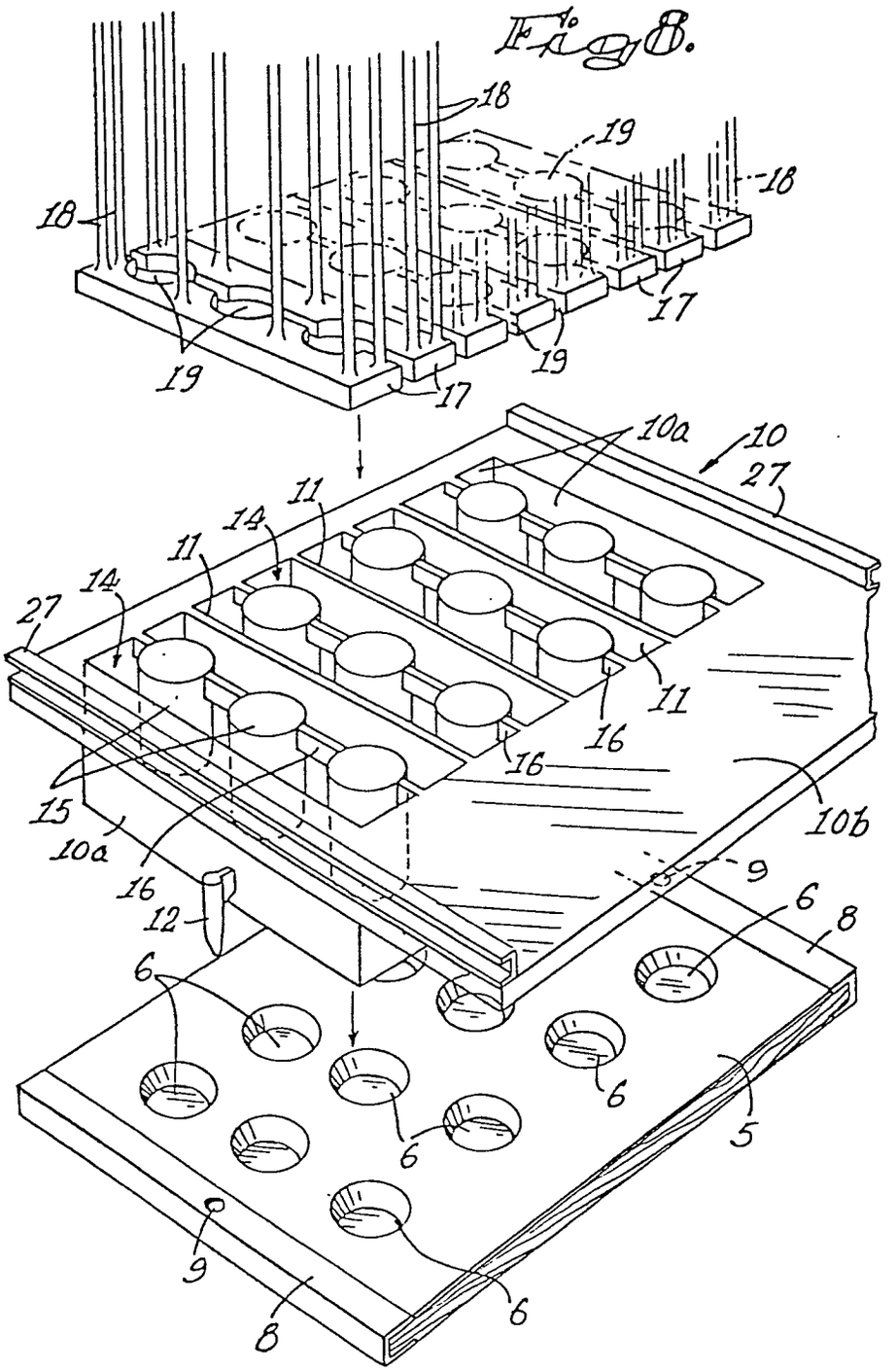
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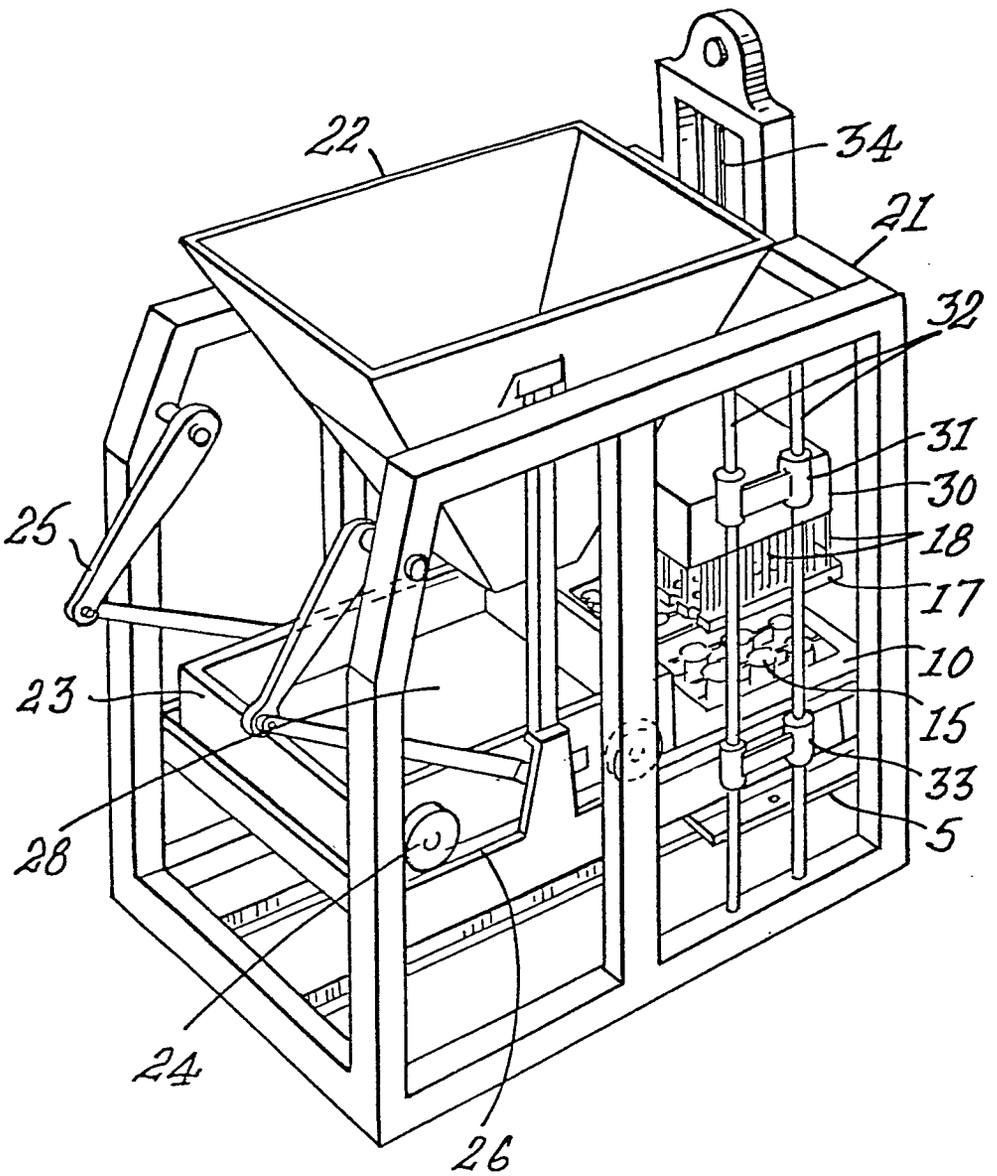
Fig 9.



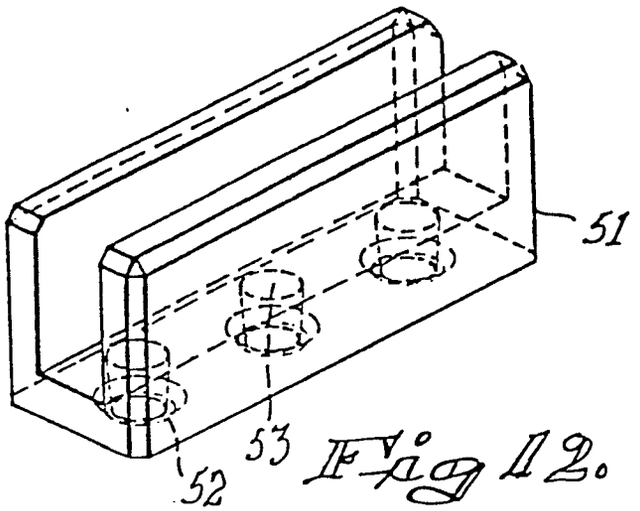


Fig 12.

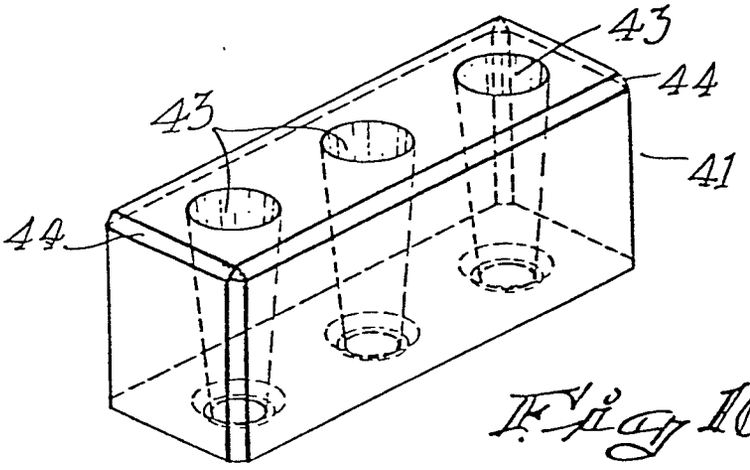


Fig 10.

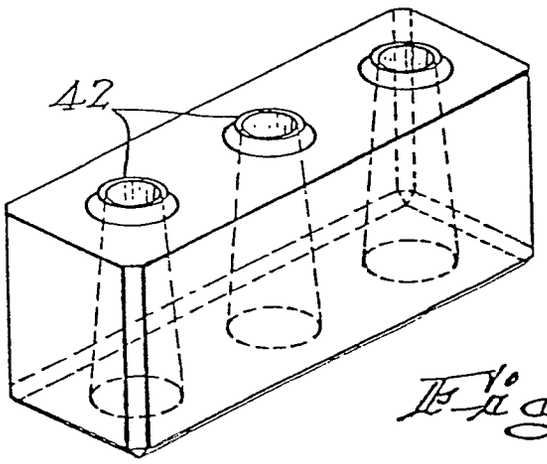


Fig 11.

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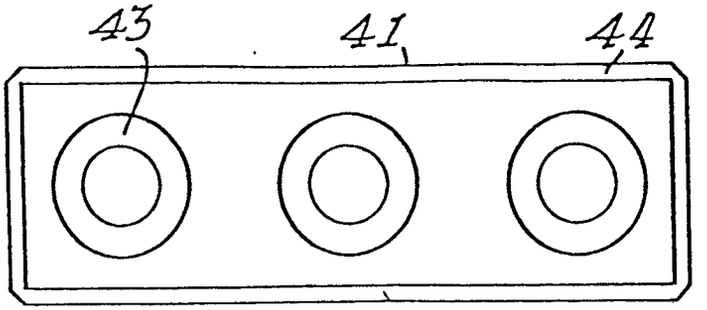


Fig 13.

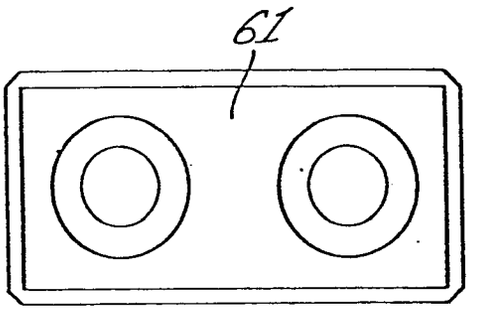


Fig 14.

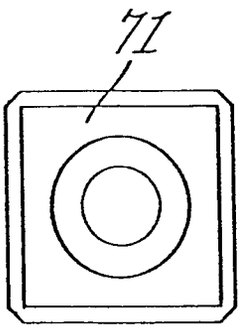
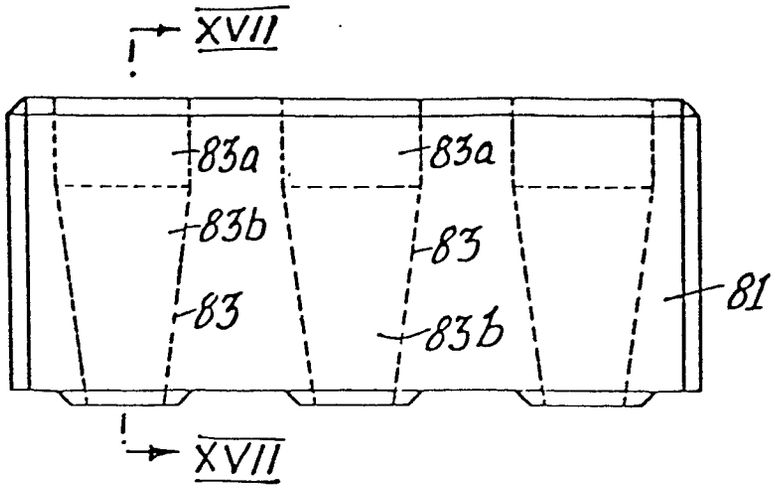


Fig 15.



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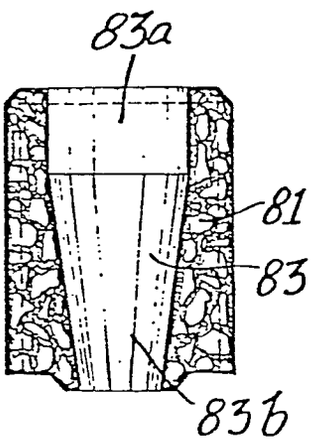

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European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 30 3595

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 344 389 (J.F. O'ROURKE) * Page 2, line 66 - page 3, line 56; figures 2-4,9,11,12 *	1,2, 12,13, 15,17, 18,22
	FR - A - 875 264 (J. MULLERS) * Whole document *	1,2,15, 17,18
	US - A - 1 697 347 (C.A. COVEY) * Page 2, lines 59-92; figures 1-3,5 *	1,2, 12,15, 17,18
X	US - A - 2 668 435 (N.T. CLEMENTS) * Column 3, line 30 - column 5, line 14; figures 1-8 *	16

CLASSIFICATION OF THE APPLICATION (Int Cl³)

B 28 B 7/16
7/18
E 04 B 2/18

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

B 28 B
E 04 B

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16-01-1981	BOLLEN