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

(11) EP 0 707 121 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.04.1996 Bulletin 1996/16

(51) Int. Cl.[6]: **E04H 7/20**, B28B 7/28, B28B 23/04

(21) Application number: **95115934.2**

(22) Date of filing: **10.10.1995**

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL PT

(30) Priority: **14.10.1994 IT PC940020**
15.09.1995 IT PC950019

(71) Applicants:
- **Parenti, Giuseppe**
  I-29100 Piacenza (IT)
- **Parenti, Cesarino**
  I-29100 Piacenza (IT)

(72) Inventors:
- **Parenti, Giuseppe**
  I-29100 Piacenza (IT)
- **Parenti, Cesarino**
  I-29100 Piacenza (IT)

(74) Representative: **La Ciura, Salvatore**
Via Francesco Sforza 3
I-20122 Milano (IT)

(54) Panels for the manufacture of circular above-ground tanks, mould, and associated manufacturing method

(57) Reinforced concrete panel for the manufacture of aboveground circular tanks, of the type comprising a wall (1) fitted with a number of horizontal stiffening ribs (3) which contain holes for the passage of pre-stressing cables, wherein the said wall is flat and the said holes are arc-shaped, and a method of manufacture of said panels comprising the following stages:

- insertion of a flexible tubular element (11), of the same length as an arc which presents a radius equal to the radius of the tank and a chord equal to the width of the panel, into a mould with mobile sides (8,9), on a pair of pegs (10) fitted to the sides at the horizontal ribs (3) of the panel; approach of the mobile sides (8,9) until the mould closes, so that the said flexible tubular element (11) takes on the arc shape required; installation of reinforcement and laying of concrete; concrete shaving; curing and removal of finished product.

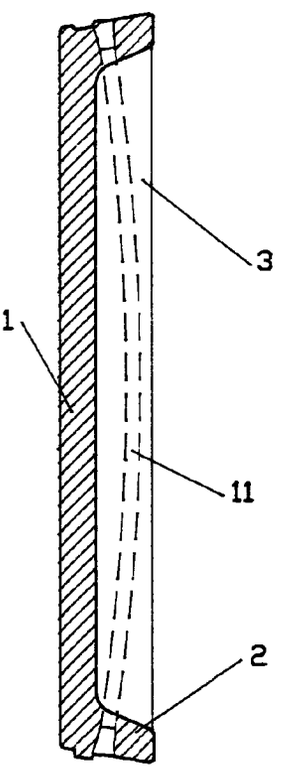


Fig. 1

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Description

The invention relates to prefabricated reinforced concrete panels for the manufacture of circular above-ground tanks, a mould for the production of the said product, and a method of manufacturing the said product. In particular, the panels are flat, with horizontal ribs containing holes for the passage of pre-stressing cables; the said holes are made by inserting into the mould, before casting, a flexible pipe whose length is such that when the mould closes, the ends of the pipe are compressed and it curves, taking on an arc shape with the same radius as the tank.

A known type of above-ground tank is made by joining a number of panels with a straight section which are placed side by side, coupled and tightened by pre-stressing cables wound round the tanks, the said cables usually being fitted on the outside of the panel, in ducts formed in the horizontal ribbing of the panels.

However, this system presents the disadvantage that the pre-stressing cables are exposed to atmospheric agents unless a further cable protection operation is performed, which typically involves filling the seating in which they are housed with mortar.

This mortar filling operation considerably increases production time and therefore labour costs.

The tanks thus obtained are also more difficult to dismantle if required.

Equally, it is inconvenient to make cable passages in this kind of panel, as it would be very difficult to insert cables dozens of metres long into a passage which is bent at an angle at the joint between each panel and the next.

Curved panels for the construction of circular tanks are also known, in which holes for the passage of pre-stressing cables are formed in the horizontal ribbing.

Panels of this kind, described, for example, in European patent 0 514 583 by the same Applicant, present the advantage of good cable protection and easy insertion because of the curved configuration of the holes.

The curved shape, however, requires more complex and therefore more expensive moulds, and the manufacturing process is more laborious as regards the laying and compacting of the concrete.

The main purpose of this invention is to eliminate the problems mentioned above by offering improved panels which allow fast, easy insertion of pre-stressing cables without the difficulties presented by known panels.

The invention also relates to the manufacturing method and associated mould. These tasks, and these and other purposes, are achieved by a product made of reinforced concrete in accordance with the characterising part of the annexed claims.

Further advantages of the invention will clearly emerge from the description of a preferred, but not the only method of manufacturing the product in accordance with the invention, which is supplied by way of example but not of limitation, with reference to the annexed figures in which:

- figures 1 to 3 are the plan view, cross-section, and front view respectively of a panel in accordance with the invention;
- figure 4 is the plan view of a further embodiment panel in accordance with the invention;
- figure 5 is the vertical cross-section of a detail of the panel;
- figure 6 is the horizontal cross-section at a joint;
- figures 7 to 10 are the plan view, cross-section, front view and side view respectively of the end panel in a tank made with the products in accordance with the invention;
- figures 11, 12 and 13 are the plan view, cross-section and front view respectively of an assembled tank;
- figures 14a and 14b schematically illustrate in cross-section a mould for the manufacture of the panels in accordance with the invention, such mould being shown open and closed respectively.

With reference to figures 1 to 4, the panel in accordance with the invention presents a flat wall 1, with vertical stiffening ribs 2 and horizontal stiffening ribs 3 located on the outer side.

This flat configuration facilitates manufacturing operations.

At the sides the panel is shaped with "male" and "female" contours shown as 4 and 5 respectively (fig.6), to form a joint which provides a secure connection between adjacent panels.

Holes are formed in horizontal ribs 3, each of which holes constitutes a passage for the pre-stressing cables.

The characteristic feature of the invention is that the panels are flat, and the holes designed for the passage of the cables are curved to an arc shape having the same radius as the tank.

This configuration involves the least possible strain on the product, and therefore the greatest possible reduction in steel reinforcement.

The invention therefore combines the advantages of flat panels, which are compact and easy to manufacture, and curved panels, in which the cables can easily be inserted.

The method of manufacturing these panels involves making the said holes by installing flexible tubular elements in the mould in a position corresponding with the ribbing; the length of the said tubular elements is greater than the distance between the walls of the mould, so that when the mould is closed, the pressure exerted on the tube curves it to the required extent.

Figure 14 shows a mould designed for the manufacture of the panels in accordance with the invention.

This mould comprises a back wall 6, a front wall 7 and a pair of side walls 8 and 9; the latter can be installed with different inclinations to give the sides of the panel the inclination required by the radius of the tank to be assembled.

A number of pairs of pegs 10 are fixed to side walls 8 and 9 at the horizontal ribs of the panel, and the same

number of flexible tubular elements 11, destined to constitute the passage for the pre-stressing cables, are fitted onto the said pegs before the mould is closed.

The length of tubular elements 11 is greater than the internal width of the mould, so that when the mould closes the side walls move together and compress tubular element 11 lengthwise into an arc shape; the longer the tubular element, the more accentuated the arc.

A simple calculation therefore suffices to determine the length of tubular element 11 so that the closing of the mould crushes it to such an extent as to produce the required radius, in particular a radius equivalent to that of the tank.

The pegs will preferably be slightly inclined towards the outer wall of the panel, to ensure that the tubular element bends in the right direction.

The sides of the mould can also advantageously be made with adjustable inclination, in order to produce panels with the side edges arranged radially in relation to the centre of the tank.

The process in accordance with the invention therefore comprises the following stages:

- insertion of a flexible tubular element, of the same length as an arc which presents a radius equal to the radius of the tank and a chord equal to the width of the panel, into a mould with mobile sides, on a pair of pegs fitted to the sides at the horizontal ribs of the panel;
- approach of the mobile sides until the mould closes, so that the said flexible tubular element takes on the arc shape required;
- installation of reinforcement and laying of concrete
- concrete shaving;
- curing and removal of finished product.

The invention thus devised could form the subject of numerous modifications and variations, all of which fall within the ambit of the invention concept.

Thus horizontal ribs 3 may be straight, or, if required by the the width of the panels, may be curved as shown in fig. 4.

In practice, any materials or dimensions can be used, as required.

Claims

1. Reinforced concrete panels for the manufacture of above-ground circular tanks, of the type comprising a wall (1) fitted with a number of horizontal stiffening ribs (3) which contain holes for the passage of pre-stressing cables, characterised by the fact that the said wall (1) is flat and the said holes are arc-shaped.

2. Panel in accordance with claim 1, characterised by the fact that the said holes have an arc shape with a radius approximately equal to the radius of the tank.

3. Panel in accordance with claim 1 or 2, characterised by the fact that the said horizontal ribs (3) are straight and the said holes for the pre-stressing cables are arc-shaped.

4. Panel in accordance with claim 1 or 2, characterised by the fact that the said horizontal ribs (3) are arc-shaped.

5. Panel in accordance with the above claims, characterised by the fact that at the sides the panel is shaped with "male" and "female" contours, to form a joint which provides a secure connection between adjacent panels.

6. Method of manufacture of concrete panels for the production of circular tanks according with any of the claims 1 to 5, characterised by the fact that it involves the following stages:

   - insertion of a flexible tubular element (11), of the same length as an arc which presents a radius equal to the radius of the tank and a chord equal to the width of the panel, into a mould with mobile sides(8, 9), on a pair of pegs (10) fitted to the sides (8, 9) at the horizontal ribs of the panel;
   - approach of the mobile sides (8, 9) until the mould closes, so that the said flexible tubular element (11) takes on the arc shape required;
   - installation of reinforcement and laying of concrete
   - concrete shaving;
   - curing and removal of finished product.

7. Mould of the type with mobile side walls (8, 9), for the production of concrete panels designed for the manufacture of circular tanks according with claims 1 to 5, characterised by the fact that the said side walls (8, 9) contain a number of supports (10) designed to allow the insertion of flexible tubular elements (11), and that the closing of the said sides causes curvature of the said flexible tubular elements.

8. Reinforced concrete panels for the manufacture of above-ground circular tanks, as described and illustrated.

9. Above-ground circular tanks made of panels in accordance with one of claims 1 to 5.

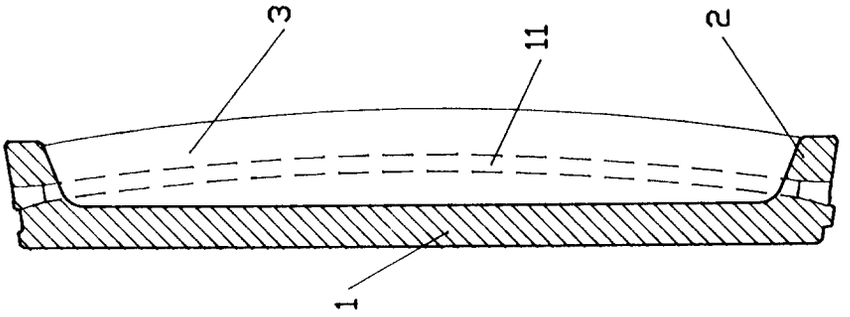


Fig. 4

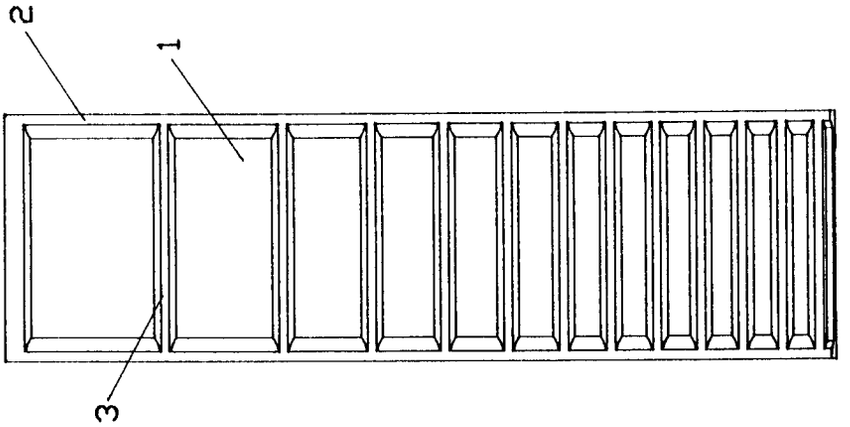


Fig. 3

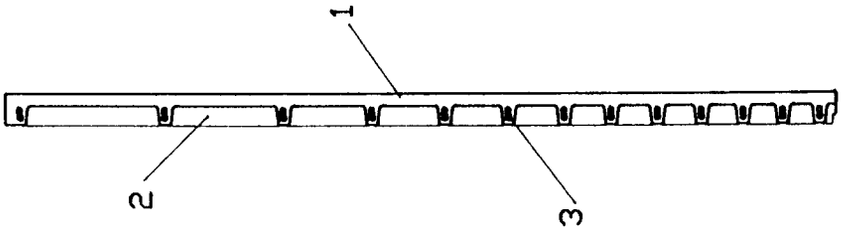


Fig. 2

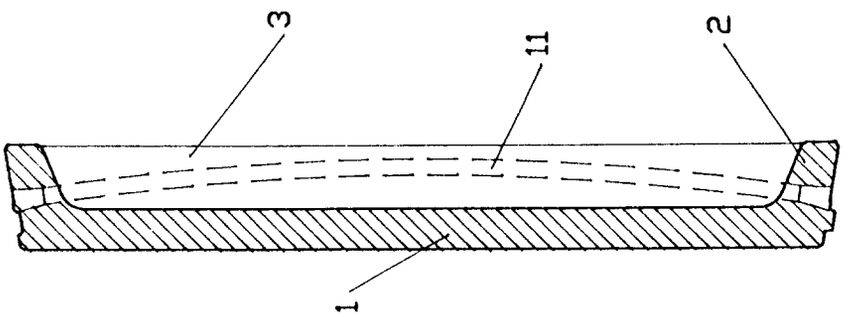


Fig. 1

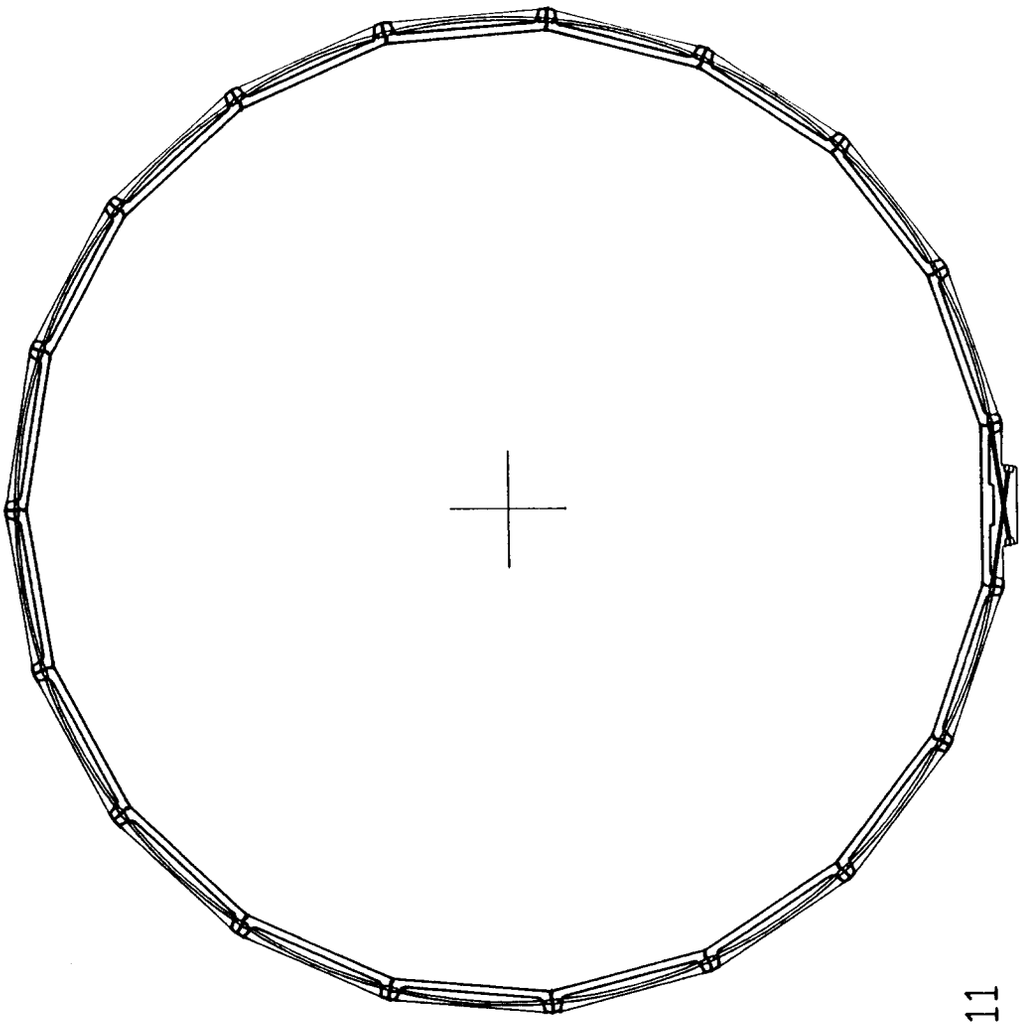


Fig. 11

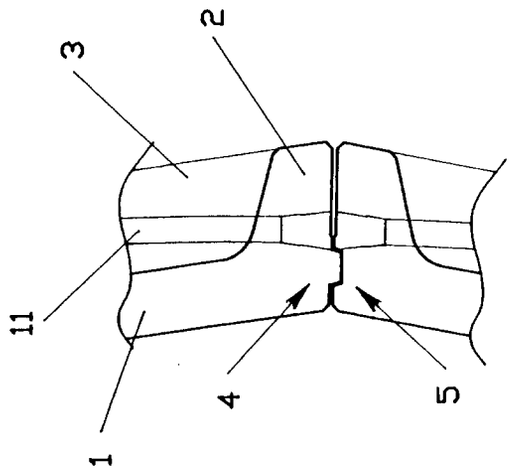


Fig. 6

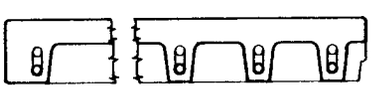


Fig. 5



Fig. 10

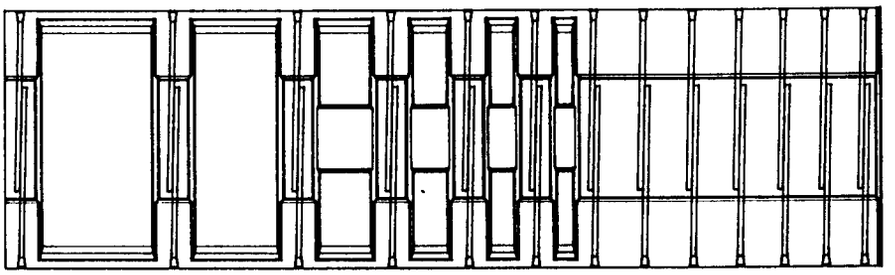


Fig. 9

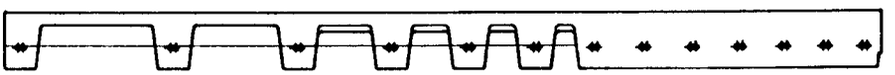


Fig. 8

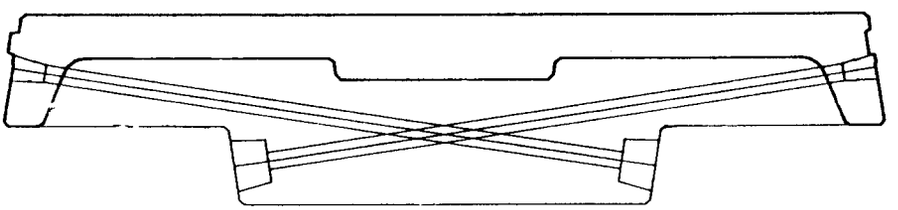


Fig. 7

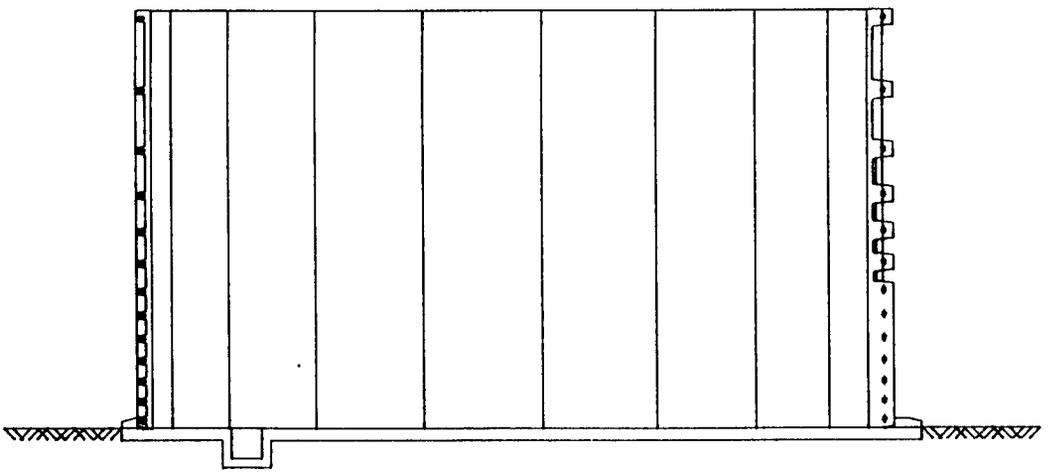


Fig.12

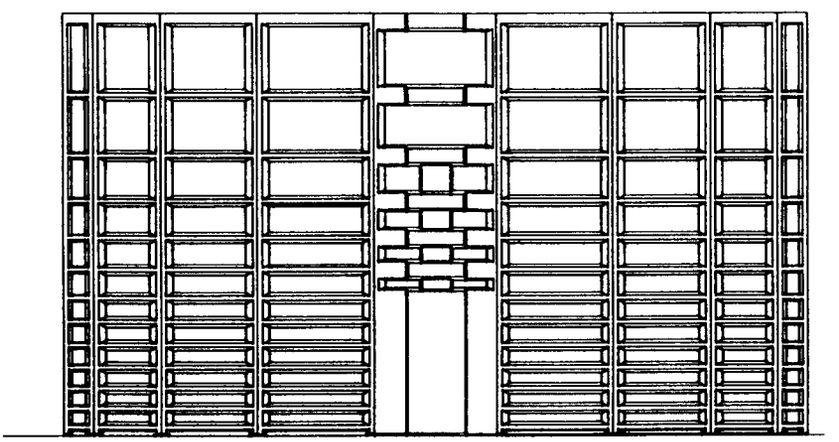


Fig.13

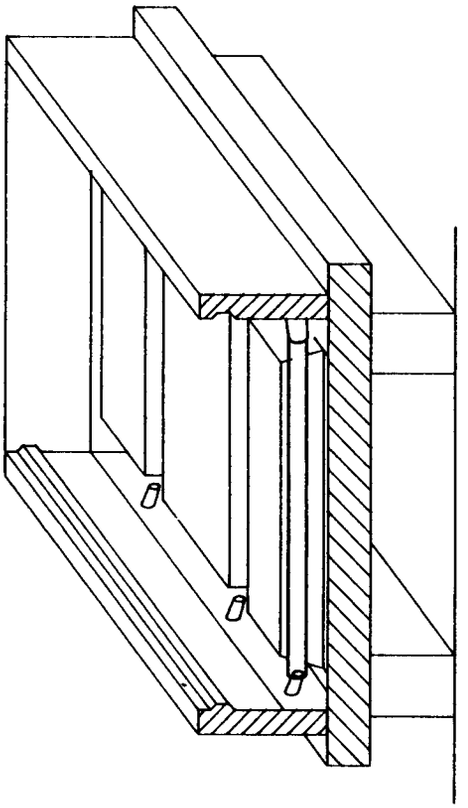


FIG.14b

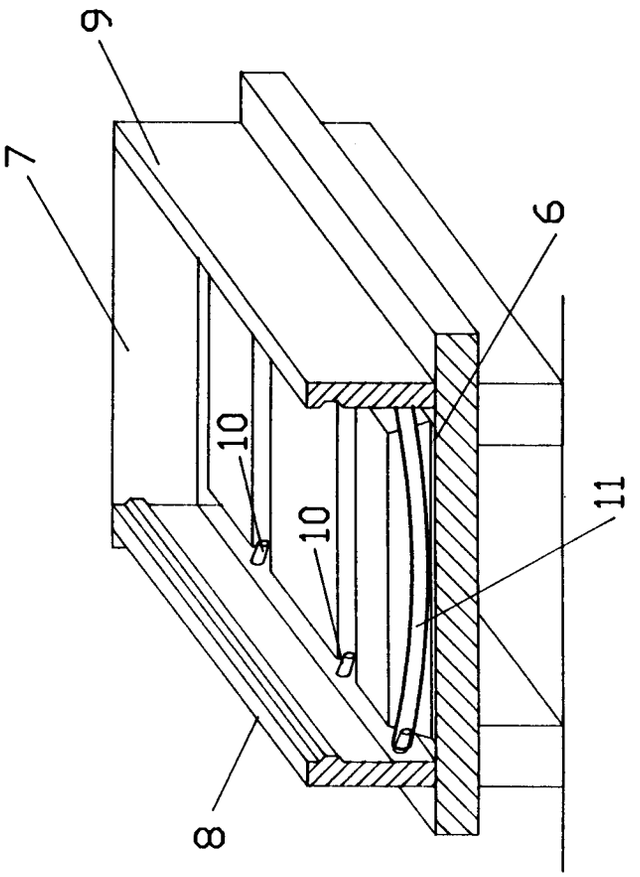


FIG.14a

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EUROPEAN SEARCH REPORT

Application Number
EP 95 11 5934

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,Y	EP-A-0 514 583 (PARENTI GIUSEPPE) 25 November 1992 * column 2, line 38 - column 3, line 48; claim 1; figures *	1,2,4,5, 8,9	E04H7/20 B28B7/28 B28B23/04
Y	DE-A-16 84 708 (W. HORNBACH) 29 July 1971 * page 5, line 10 - line 16 * * page 6; figures 2,4,6,7 *	1,2,4,5, 8,9	
A		3	
A	FR-A-2 502 221 (AUXILIAIRE ENTREPRISES SOC) 24 September 1982 * page 5, line 3 - line 29; claim 1; figures 4,6,7 *	1,2,4	
A	EP-A-0 207 337 (P. LARSEN) 7 January 1987 * page 10, line 1 - line 25 * * page 11, line 27 - page 12, line 10; figures 3,6,7 *	1-3	
A	AT-A-302 921 (F. ÖSTREICHER) 15 September 1972 * page 2, line 9 - line 17 * * page 2, line 44 - page 3, line 4; figures *	1,2,4	TECHNICAL FIELDS SEARCHED (Int.Cl.6) E04H B28B
A	FR-A-1 010 934 (A. BLATON) 17 June 1952 * the whole document *	6,7	
A	GB-A-682 320 (STRESSED CONCRETE DESIGN) 5 November 1952 * page 2, line 64 - page 3, line 39; figures *	6,7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 January 1996	Kriekoukis, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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