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**(54) Beam element, building system and method**

(57) The present invention provides a beam element (40), comprising a beam member (42) provided with a reinforcement (46,48) for supporting a floor element, the reinforcement at least partly extending beyond the beam

member (42) in order to form a load-bearing structure. The load-bearing structure comprises an elongate bar member to which supporting elements are attached at an angle in order to absorb pressure force.

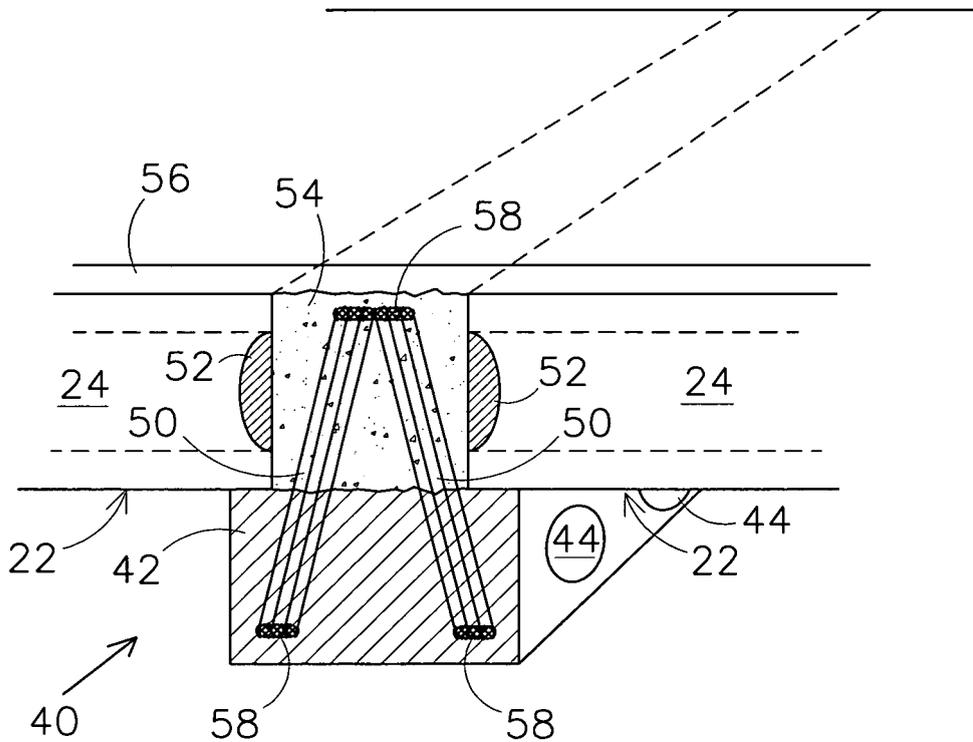


Fig 3

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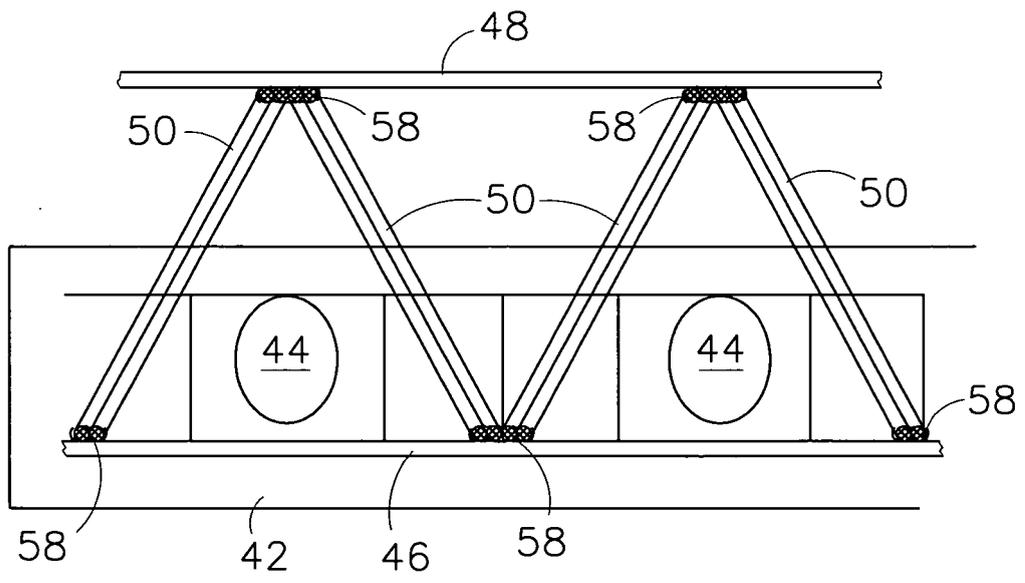


Fig 4

## Description

**[0001]** The present invention relates to a beam element, to a building system which uses the beam element and to a method for constructing a building using the beam element.

**[0002]** The building system may comprise all structural components for constructing a building. The building system, the beam element and/or the method may be used in the construction of houses as well as the construction of offices and commercial properties.

**[0003]** Known buildings, such as apartment buildings, are constructed from concrete building elements. Vertical columns are connected to one another by horizontally fitted metal profiled sections. Known metal profiled sections comprise a flat flange, on which a frustoconical bent profiled section is arranged. Due to the shape of the cross section, the known profiled section is also referred to as a "hat girder", as, in use, the bent profiled section is above the flat flange. Floor panels are arranged on the flange extending laterally relative to the bent profiled section in order to form a floor of the building. On top of the metal profiled section, concrete is then applied in order to create a connection between the floor panels and the metal profiled section and in order to create a floor, the upper surface of which is flat.

**[0004]** Buildings may comprise a detachable system floor or a detachable system ceiling in order to hide lines from view. The lines, such as electrical wires, sewage pipes, heating pipes, wires of a computer network or for air conditioning, are arranged between floor panels of the building and the system floor and system ceiling, respectively.

**[0005]** The above-described metal profiled sections are relatively expensive. In addition, the metal of the profiled section can melt if a fire breaks out in the building.

**[0006]** It is an object of the present invention to provide a building element which can serve as an alternative to the abovementioned metal profiled section. To this end, the invention provides a beam element, comprising:

- an elongate beam member for supporting a floor element; and
- a reinforcement extending over at least a part of the length of the beam member, comprising an internal part which is arranged in the beam member and an external part which is arranged outside the beam member,

the external part being designed to resist pressure forces which occur when the floor element is placed on the beam member.

**[0007]** The beam element is a fully equivalent replacement of the known metal profiled section in terms of load-bearing capacity and strength but is at the same time significantly cheaper. The cost savings achieved by using a beam element according to the invention for transverse connections between columns or other building ele-

ments, such as walls and similar structures, is for example approximately 50%. Its use for constructing buildings is possible because the external part of the reinforcement is capable of resisting the pressure force which acts on the external part when a floor element is placed on the beam member.

**[0008]** In one embodiment, the external part of the reinforcement comprises a bar member which extends approximately parallel to the beam member and to which supporting elements are attached at an angle. The supporting elements attached at an angle to the bar member prevent the bar member from buckling.

**[0009]** In one embodiment, the supporting elements are attached by means of at least a double weld. Consequently, forces exerted on the bar member are virtually completely transferred to the supporting elements. If only one weld seam is used, a supporting element may bend or hinge about the weld seam and may even break away. By using two weld seams, preferably opposite one another on a supporting element when viewed head on, the weld seams cannot act as a pivot and, at the same time, a stronger connection is achieved. Simultaneous welding of the two seams prevents the supporting element from becoming warped during welding. Simultaneous welding is preferably carried out using a welding robot, which not only welds simultaneously, but also for an equal period and over an equal length of every weld seam. In this manner, identical and strong welded joints are produced which generate as little tension as possible in the bars.

**[0010]** The double weld may have a cross-sectional area which is larger than or equal to the cross-sectional area of the respective supporting element, thus transferring the forces as completely as possible.

**[0011]** In one embodiment, a duct is arranged in the beam member which extends from one side of the beam member to another side. The duct forms a passage for lines. The beam element can thus be used in combination with system ceilings. Lines which are arranged on the system ceiling can run through the duct.

**[0012]** The internal part of the reinforcement may comprise several bar members which extend approximately parallel to a longitudinal axis of the beam member. These bar members arranged in the beam member ensure that the tensile force which is exerted on the beam member, for example when a floor element is placed thereon, is absorbed.

**[0013]** The bar members may be connected to the supporting elements of the external part of the reinforcement.

**[0014]** In one embodiment, the duct extends in a width direction of the beam member.

**[0015]** An above-described beam element is rigid and has a large load-bearing capacity. The reinforcement is for example made of metal, such as steel and in particular reinforcing steel. Furthermore, the supporting elements and/or the bar members may be tubular, thereby further increasing the strength of the reinforcement.

**[0016]** According to a further aspect, the invention provides a building system for constructing a building, com-

prising a beam element such as described above.

**[0017]** In one embodiment, the beam element of the building system is provided with a duct, a floor element extending laterally from the beam element and a system ceiling extending laterally from the beam element which is arranged below the floor element in order to form an intermediate space, the duct of the beam element adjoining the intermediate space between the floor element and the system ceiling.

**[0018]** Lines can thus be moved, replaced, repaired or added relatively easily. It is also possible to fit additional connections to lines. Contrary to what is the case when a prior art solid concrete beam or metal profiled section is used, no chases have to be cut in order to make modifications, as the beam element comprises a duct which adjoins the space between the floor and the system ceiling. The reinforcement of the beam element according to the invention has a load-bearing capacity which is such that the ducts can be recessed in the concrete.

**[0019]** According to another aspect, the invention provides a method for constructing a building, comprising the steps of:

- placing a beam element between two building elements, the beam element comprising:
- an elongate beam member for supporting a floor element; and
- a reinforcement extending over at least a part of the length of the beam member, comprising an internal part which is arranged in the beam member and an external part which is arranged outside the beam member, the external part being designed to resist pressure forces which occur when the floor element is placed on the beam member;
- placing a floor element extending laterally from the beam element on the beam element;
- embedding the external part of the reinforcement in a setting material.

**[0020]** In one embodiment, the setting material is concrete. Concrete has properties which are suitable for bringing about a connection. The building elements comprise upright building elements, such as columns, walls and similar structures.

**[0021]** Further advantages and features of the present invention will be explained below in more detail with reference to the accompanying drawings, in which:

Fig. 1 shows a top view of an embodiment of a system according to the present invention, comprising a column, beam elements and floor elements placed thereon;

Fig. 2 shows a perspective view of a floor comprising floor panels and a system ceiling arranged underneath it, on line B-B;

Fig. 3 shows a perspective sectional view of an em-

bodiment of the system of Fig. 1 on line A-A;

Fig. 4 shows a view of a beam element as shown in Fig. 3;

Fig. 5 shows a section of another embodiment of the system from Fig. 1 on line A-A;

Fig. 6 shows a view of a beam element as shown in Fig. 5;

Fig. 7 shows a perspective view of an embodiment of the beam element according to the present invention;

Fig. 8 shows a diagrammatic perspective view of a bar member and a supporting element provided with a double weld according to the invention;

Fig. 9 shows a diagrammatic section of the double weld from Fig. 8.

**[0022]** A building constructed using a building system 1 according to the present invention comprises floors, wall elements and beam elements and columns. The floors comprise floor elements or floor panels. The columns 2 are arranged at corners of the floors and are placed vertically, at right angles to the floor. The beam elements 4, 6 are arranged under the edges of the floor elements 8 and extend horizontally from column to column. The beam element 6 comprises a bottom part 10 which is wider than a top part 12 arranged on top thereof. The edge 14, formed by the part of the bottom part 10 which protrudes relative to the top part 12, supports the floor elements 8.

**[0023]** The floor elements may be hollow floors, as introduced onto the market by the applicant. The floor elements may also comprise standard floor panels available on the market, such as duct panels, see Fig. 2.

**[0024]** The floor 20 shown in Fig. 2 comprises floor panels 22. The floor panels are concrete duct panels which are flat and elongate. Openings 24 which extend through the entire panel are provided in the longitudinal direction. This saves building material and thus costs, while the load-bearing capacity of the floor panels remains sufficient. With the system described with reference to Fig. 1, the floor panels with ends 26 are arranged on the edge 14 of the beam elements. The floor panels have side walls 28, 30 which are arranged at an angle relative to the top and bottom surface.

**[0025]** In Fig. 2, a system ceiling 32 is arranged under the floor panels 22. The system ceiling is commercially available and can be detached in parts. The system ceiling is attached to the floor panels 22 in a suitable manner by means of attachment bars 34.

**[0026]** The first embodiment of a beam element 40 according to the invention shown in Fig. 3 comprises a beam member 42. The beam member 42 as illustrated is an elongate beam which has cylindrical passages or ducts 44 running through it in the width direction, approximately parallel to one another. The ducts 44 extend through the entire beam member 42, from side to side. Floor panels 22 are placed on the beam member 42, which floor panels correspond to the floor panels shown in Fig. 2 and are

provided with ducts 24. The ends of the ducts 24 are sealed with sealings 52. The sealings 52 may have any suitable form and comprise any suitable material, for example a stopper or plug made of plastic. A setting material is arranged between the floor panels and on the beam member 42 in order to form the top part 54 of the beam element. The setting material is for example concrete which is applied on the bottom part 42 during the construction. Once the concrete has set, an optional finishing layer 56 is arranged on top thereof. The finishing layer 56 comprises, for example, a carpet, a concrete layer, parquet, a sound-dampening layer, etc.

**[0027]** The beam element 40 is partly prefabricated (prefab) and is supplied as shown in Fig. 4. The bottom part 42 contains a reinforcement, which reinforcement comprises bars 46, 48 which are connected to one another by supporting elements 50. The bars 46, 48 are approximately parallel and extend over approximately the entire length of the bottom part. In the embodiment shown, the supporting elements are straight bars which are attached to a bar 46 by a first end and by a second end to a bar 48. The supporting elements 50 partially extend outside the material of the beam member or bottom part 42. Together with the bar 48, this part of the supporting elements forms an external part of the reinforcement. Both in front view (Fig. 3) and side view (Fig. 4), the supporting elements 50 are connected to the bar 48 at an angle. Thus, the external part of the reinforcement is able to absorb pressure forces which arise when a floor element is placed on the beam member 42, see Fig. 3. Deformation, i.e. buckling, of the bar 48 is prevented by the supporting elements 50 which are arranged at an angle and produce a counterforce in the plane of a floor panel.

**[0028]** As shown, both the bar members 46, 48 and the supporting elements 50 may comprise one or more bars. If several bars are being used, these may be arranged parallel to one another, as shown.

**[0029]** The ends of the supporting elements are welded to the bars 46, 48. Preferably, a weld 58 is provided on two or more sides of the end, which is referred to as a double weld, see also Figs. 8 and 9. The double weld forms a strength weld, which transfers virtually all the force exerted on a supporting element onto the bar member to which it is attached.

**[0030]** Another embodiment of the beam element 70 is supplied from a factory in the shape of beam member 72, as shown in Figs. 5 and 6. The beam member contains a reinforcement comprising bars 74, 76 which are connected to one another by supporting elements 78. The supporting elements are attached to the bar 76 at an angle of, for example, 60 degrees. The supporting elements meet on the bar 76 in the shape of a pyramid. The external part of the reinforcement 80 comprises that part of the supporting elements which falls outside the bottom part 72, as well as bar 76. Openings 82 extending through the beam member 72 are disposed between the supporting elements 78. The openings may have any

desired shape, such as the frustoconical shape shown in Fig. 5.

**[0031]** Constructing a building using the beam elements according to the invention is explained with reference to Fig. 7. The beam elements are supplied by the factory as shown in Fig. 5. The beam element 70 is placed horizontally between two columns 2. To this end, the column 2 for example comprises a widened support (not shown) on which the beam element comes to rest. The floor panels 22 are then placed on the beam element 70 and next to the external part of the reinforcement 80. The space between the floor panels is filled by applying concrete on top of the beam member 72, in order to form the top part 84 of the beam element. The ducts of the floor panels 22 are in this case sealed as shown in Fig. 3 in order to prevent the concrete from flowing into the ducts. After this step, the external part 80 is embedded in the concrete 84.

**[0032]** The floor elements 22 are optionally anchored to one another by an anchoring member 86 which extends in the plane of the floor panels. The anchoring member 86 is fitted through the top part 84 of the beam element. If desired, a coupling element 88 is furthermore arranged in a floor element. Other building elements can be fitted to the coupling element, even after the construction of a building has finished.

**[0033]** Between the step of placing the floor panels onto the beam element and applying the concrete for forming the top part 84, the beam member, i.e. the bottom part of the beam element, supports the floor panels 22. In this case, the beam member experiences a (gravitational) force in the direction of the ground between the support at both ends. The beam member is thus subjected to tensile load, while the external part of the reinforcement is subjected to compressive load in the longitudinal direction of the bar 76. The external part 80 of the reinforcement is sufficiently strong to withstand the pressure force exerted on it without deformation. Buckling of the bar 76 is prevented since the supporting elements are attached by means of double welds, or a strength welds, to the bar 76 and thus transmit pressure forces. Furthermore, the supporting elements 78 are connected to the bar at an angle in order to secure the bar in the transverse direction.

**[0034]** After the concrete of the part 84 has set, the external part 80 of the reinforcement is embedded in concrete, so that any forces acting on it are likewise absorbed by the concrete. The entire structure, as shown in Fig. 7, is thus sturdy and has a long service life. The concrete of the beam element is fire resistant. At the same time, the beam element costs significantly less in terms of production, transportation and installation than a metal profiled section. The cost savings may amount to more than 50%.

**[0035]** The ducts 82 are arranged in the beam member 42 in such a manner that the ducts connect to the space between a system ceiling 32 and the floor elements 22. It is possible for lines to extend through the ducts 82 of

the beam element, which lines are still accessible once the construction of the building has finished.

**[0036]** The beam member 72 is cast in a shuttering containing a reinforcement and optionally tubes or blocks for creating the ducts.

**[0037]** Fig. 8 shows a double weld 90 according to the invention. Supporting element 78 is attached to bar 76 by applying a weld 92, 94 at one end of the supporting element on two opposite sides.

**[0038]** Fig. 9 shows that the joint surface area of the welds 92, 94 is greater than or equal in size to the surface of the supporting element 78. Thus, a strong coupling is achieved, in which the forces exerted on the supporting element are completely passed on to the bar 76.

**[0039]** If the beam elements were made of solid concrete, the concrete surrounding the reinforcement would absorb the transverse forces. However, a solid concrete beam is relatively heavy, resulting in high transport costs. Furthermore, when using a solid beam element in combination with a system ceiling, a passage for the lines is absent. Due to the hardness of the material, creating ducts or slots in a solid concrete beam is very labour-intensive and causes a nuisance due to the chases which have to be cut.

**[0040]** The present invention provides a beam element which is provided with one or more ducts in which lines can be introduced. The ducts of the beam elements connect to the intermediate space between the floor panels 22 and the system ceiling 32. The entire unit thus provides a complete system for the passage of lines. The ducts can be accessed by partly removing the system ceiling in order to make modifications. Furthermore, a saving in weight has been made in order to transport the beam elements.

**[0041]** The present invention provides a complete system for the construction industry. The beam elements act as beam binders where two floor parts meet. At the same time, the beam acts as a passage for lines, so that it is optionally suitable for use in combination with a system ceiling.

**[0042]** As concrete beams are normally solid, the transverse forces occurring when the floor parts are being installed are absorbed by the concrete. With the beam element according to the present invention, it appears that the transverse forces can be absorbed by the zigzag arrangement of the supporting elements. The concrete which would normally absorb the transverse forces can (temporarily) be omitted with the beam element according to the invention in order to provide openings, since the reinforcement, inter alia as a result of the welding method used, is sufficiently strong to absorb the transverse forces.

**[0043]** The beam element of Figs. 3 and 7 may have a width of approximately 55 cm and a height of 40 cm. The length is for example between 5 m and 20 m. The supporting elements are at an angle of for example 60 degrees with respect to one another. The supporting elements are, for example, at an angle of 50 to 60 degrees

relative to the bar 225.

**[0044]** The beam elements are coupled to the floor elements. The coupling can for example be brought about by the following two methods. 1) The beam elements are coupled to the floor elements by an anchoring, the first end of which is provided in the beam element and the second end of which is provided in a floor element. 2) The beam elements are coupled to the floor elements by a mechanical coupling made of steel, for example using anchored bolts and nuts fitted thereto.

**[0045]** In one practical embodiment of the building elements, the supporting elements of the reinforcement have a diameter of 16 mm or more, for example of approximately 28 mm. Both ends of the supporting elements are attached to the bars by means of double welds in order to prevent pretensioning the supporting elements.

**[0046]** The supporting elements and the bars of the reinforcement are made of high-performance steel, such as torsteel, reinforcing steel or constructional steel.

**[0047]** The edge 14 of the beam element (Fig. 1), for example, laterally protrudes approximately 150 mm relative to the top part 12.

**[0048]** The building system and the beam element according to the present invention are suitable for use in buildings where a system ceiling has been installed due to the fact that the configuration of lines changes relatively often. Examples include hospitals and office buildings.

**[0049]** The present invention is not limited to the embodiments described above, to which many modifications can be made without departing from the scope of the attached claims.

## Claims

### 1. Beam element comprising:

- an elongate beam member for supporting a floor element; and
- a reinforcement extending over at least a part of the length of the beam member, comprising an internal part which is arranged in the beam member and an external part which is arranged outside the beam member,

the external part being designed to resist pressure forces which occur when the floor element is placed on the beam member.

### 2. Beam element according to claim 1, in which the external part of the reinforcement comprises a bar member which extends approximately parallel to a longitudinal axis of the beam member and to which supporting elements are attached at an angle.

### 3. Beam element according to claim 2, in which the

supporting elements are attached by means of at least a double weld.

4. Beam element according to claim 3, in which the double weld has a cross-sectional area which is larger than or equal to the cross-sectional area of the respective supporting element. 5
5. Beam element according to one of the preceding claims, in which the internal part of the reinforcement comprises two or more bar members which extend approximately parallel to a longitudinal axis of the beam member. 10
6. Beam element according to claim 5, in which the bar members are connected to the supporting elements of the external part of the reinforcement. 15
7. Beam element according to one of the preceding claims, in which a duct is arranged in the beam member in order to provide a passage through the beam member. 20
8. Building system for constructing a building, comprising a beam element according to one of the preceding claims. 25
9. Method for constructing a building, comprising the steps of: 30
  - placing a beam element between two building elements, the beam element comprising:
    - an elongate beam member for supporting a floor element; and 35
    - a reinforcement extending over at least a part of the length of the beam member, comprising an internal part which is arranged in the beam member and an external part which is arranged outside the beam member, 40
  - the external part being designed to resist pressure forces which occur when the floor element is placed on the beam member; 45
  - placing a floor element extending laterally from the beam element on the beam element;
  - embedding the external part of the reinforcement in a setting material. 50
10. Method according to claim 9, in which the setting material is concrete. 55

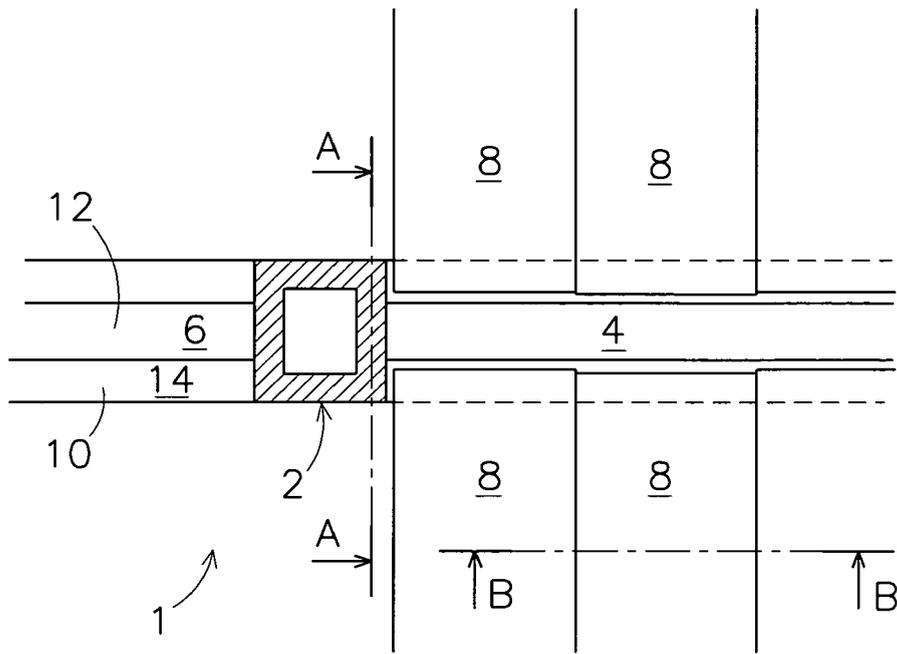


Fig 1

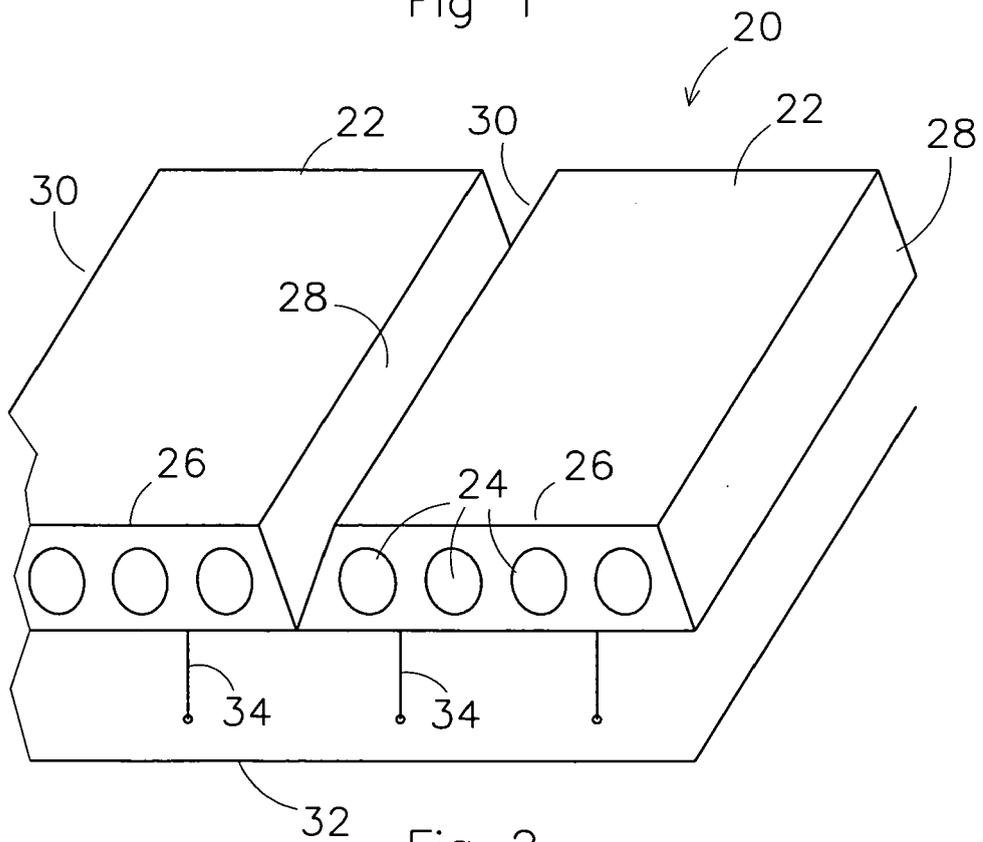


Fig 2



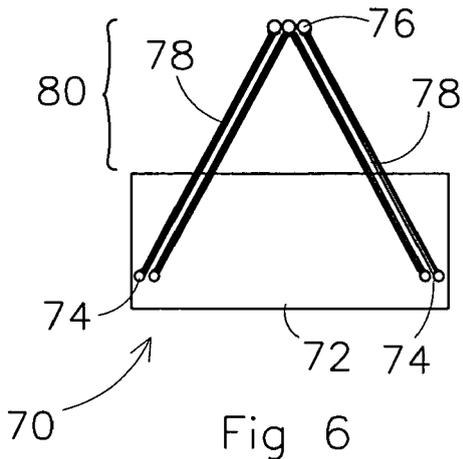


Fig 6

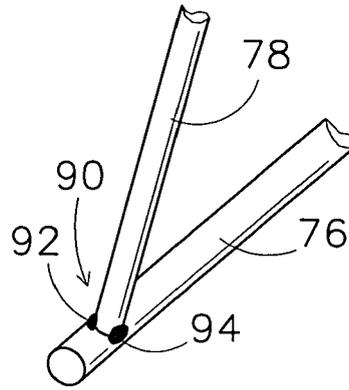


Fig 8

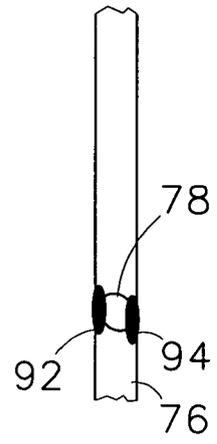


Fig 9

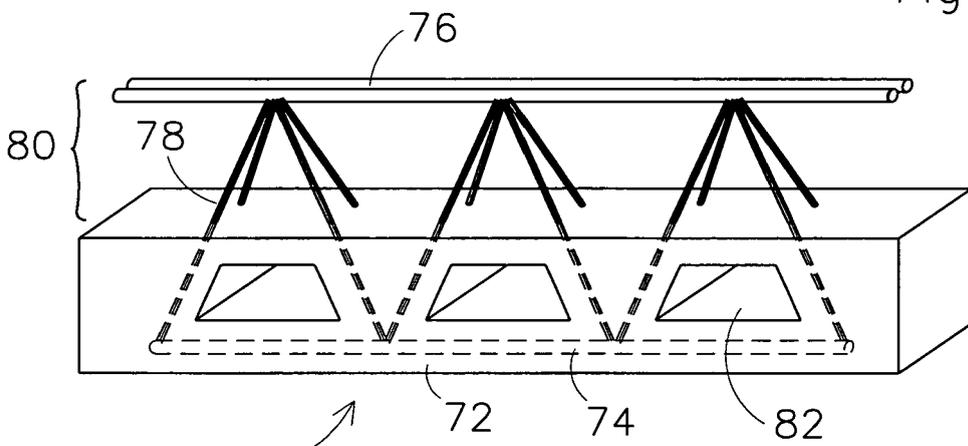


Fig 5

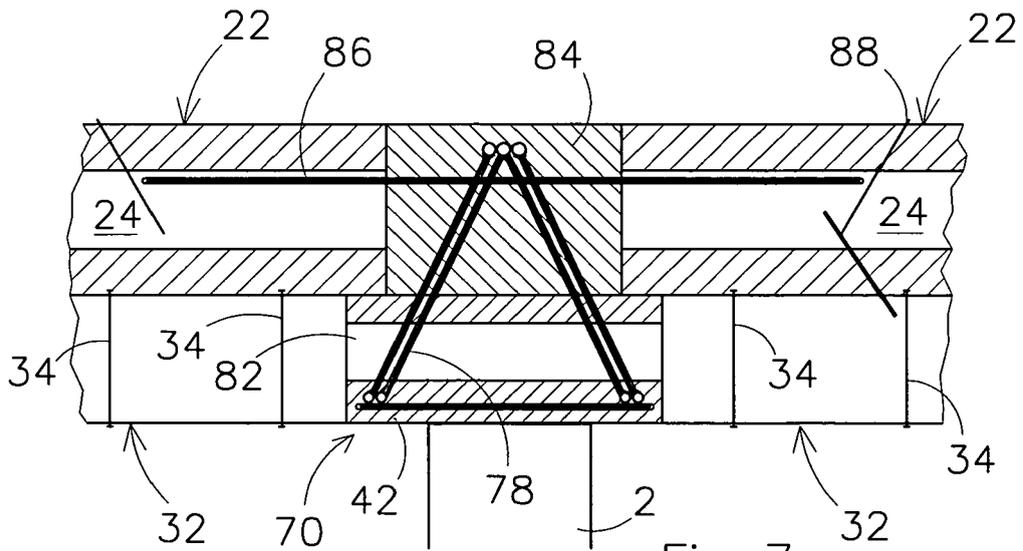


Fig 7



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 697 857 A (COTE FRANCOIS) 13 May 1994 (1994-05-13)	1,2,5,6, 8-10	INV. E04B5/26
Y	* page 1, line 1 - page 3, line 27; figures 2,7 *	3,7	E04C5/065
	-----		
X	WO 00/77315 A (MIHANOVI&CACUTE) 21 December 2000 (2000-12-21)	1,2,5,6, 8-10	
Y	* the whole document *	3,7	
	-----		
Y	EP 1 600 573 A (BARTOLI N.V) 30 November 2005 (2005-11-30)	3	
A	* paragraph [0025]; figures 1-3 *	1	
	-----		
Y	EP 1 146 180 A (HUK, UTE; SIMON, WERNER DIPL.-ING; SIMON, WERNER) 17 October 2001 (2001-10-17)	7	
	* paragraph [0032]; figures 1a,2a *		
	-----		
			TECHNICAL FIELDS SEARCHED (IPC)
			E04B E04C
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		7 September 2006	Stern, Claudio
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

1 EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 07 7844

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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07-09-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 2697857	A	13-05-1994	NONE	
-----				
WO 0077315	A	21-12-2000	AU 5095600 A	02-01-2001
			HR 990191 A2	31-08-2001
			SI 20429 A	30-06-2001
-----				
EP 1600573	A	30-11-2005	NL 1026256 C2	28-11-2005
-----				
EP 1146180	A	17-10-2001	AT 311503 T	15-12-2005
			DE 10018212 A1	25-10-2001
			DE 50108213 D1	05-01-2006
-----				