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(11) **EP 1 249 551 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
16.10.2002 Bulletin 2002/42

(51) Int Cl.7: **E04C 3/29, E04B 1/14**

(21) Application number: **02005342.7**

(22) Date of filing: **14.03.2002**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **16.03.2001 IT PD010064**

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(54) **Supporting structure for erecting building constructions**

(57) A supporting structure for erecting building constructions, constituted by longitudinally elongated bod-

ies (10), each of which comprises at least one outer layer (11) made of carbon fiber impregnated with at least one epoxy resin.

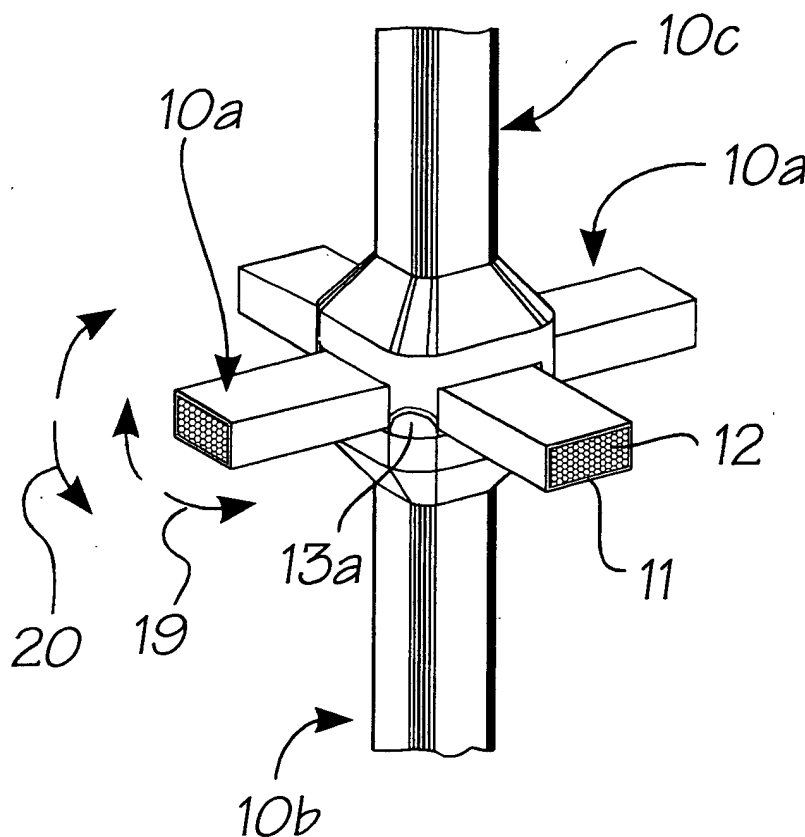


Fig. 4

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Description

[0001] The present invention relates to a supporting structure for erecting building constructions.

[0002] The invention is particularly suitable in the construction sector for example for buildings, bridges, and building structures exposed to atmospheric agents.

[0003] It is known that supporting structures that use trusses made of profiled elements made of metal (typically steel) or concrete, mostly reinforced with internal frames of iron rods, are widely used for building constructions.

[0004] Acknowledged limitations of structures erected with these trusses are most of all weight and labor-intensive installation.

[0005] The aim of the present invention is to provide a new supporting structure for erecting building constructions that is lighter than current ones made of reinforced concrete and at the same time has improved mechanical characteristics.

[0006] Within this aim, a consequent primary object is to improve the resistance of building constructions to destabilizing events such as earthquakes, floods, tidal action, atmospheric agents and the like.

[0007] Another important object is to provide a supporting structure for erecting building constructions whose installation is simpler and quicker than current ones.

[0008] This aim and these and other objects that will become better apparent hereinafter are achieved by a supporting structure for erecting building constructions, characterized in that it is constituted by longitudinally elongated bodies, each of which comprises at least one outer layer made of carbon fiber impregnated with at least one epoxy resin.

[0009] Advantageously, said longitudinally elongated bodies have a porous plastic core that fills the space inside said at least one layer of carbon fiber.

[0010] Conveniently, the plastic material has an open-cell porous structure.

[0011] Conveniently, the plastic material has a honeycomb structure.

[0012] Further characteristics and advantages of the present invention will become better apparent from the detailed description of some embodiments thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figures 1 to 3 are perspective views of respective bodies according to the invention;

Figure 4 is a perspective view of a region where posts and beams having the structure according to the invention are joined;

Figure 5 is a partially exploded perspective view of the joint region of Figure 4;

Figure 6 is an enlarged-scale view of the joint region of Figure 4;

Figure 7 is a top view of the lower post of the joint region of Figure 4;

Figure 8 is an exploded bottom view of the joint region of Figure 4.

[0013] With reference to the figures, a supporting structure for erecting building constructions is constituted by longitudinally elongated bodies 10, which have for example a polygonal (square, rectangular) cross-section, a T-shaped cross-section, an H-shaped cross-section, an L-shaped cross-section or the usual cross-sections used for metal profiled elements.

[0014] Each one of the longitudinally elongated bodies 10 comprises at least one outer layer 11 made of carbon fiber, impregnated with at least one epoxy resin.

[0015] The carbon fiber fabric can also be made of strands according to Italian Patent Application No. PD2000A000005 dated 13 January 2000, which are composed of filaments of which at least one is made of metal and at least one is made of carbon fiber.

[0016] It is also possible to interweave the carbon fiber fabric with ceramic fibers.

[0017] As regards the impregnating epoxy resin, which also acts as an adhesive, it is possible to use a resin that polymerizes at ambient temperature and is commonly commercially available, particularly on the US market, and manufactured by CIBA GEIGY.

[0018] It is also possible to use a resin that is activated at a higher temperature than the ambient temperature if a heating chamber is available.

[0019] Each one of the longitudinally elongated bodies 10 has a core 12 made of porous plastics, for example a foamed resin, which fills the space inside said at least one layer 11 of carbon fiber.

[0020] A foamed resin with an open-cell porous structure, for example of the honeycomb type, is preferable.

[0021] From the point of view of production, by way of example, it is possible to provide first of all a metal mold in which the outer layer 11 is produced with the usual techniques used for carbon fiber.

[0022] After extraction from the mold, the outer layer 11 is filled with the core 12, which by polymerizing adheres completely thereto, forming a structural continuity that makes it share the mechanical resistance to stresses, particularly vibratory stresses.

[0023] It should be noted that the number of layers 11 for each longitudinally elongated body 10 is advantageously proportional to the load that the beam is intended to bear.

[0024] In the case of bodies 10 for buildings, the number of layers 11 can therefore be conveniently smaller for beams meant for the upper floors than for beams meant for the lower floors.

[0025] Also according to the present invention, complementary male and/or female coupling elements 13, 14 are rigidly coupled to the heads of the bodies 10, for example for mutually joining a beam and a post when the bodies 10 perform these functions (see in Figures 4 to 8 the beam 10a and the pillar 10b, the pillar having an appropriately wider head).

[0026] The male coupling element 13 is constituted by a dome 15 made of permanent magnet, which is preferably hemispherical and is monolithic with, or applied to, the body of the pillar 10b (for example by means of an interlocking coupling 18 and a monolithic coupling by means of adhesives or the like), arranged at one end in a number of units that corresponds to the number of beams 10a to be arranged with a resting coupling (in the figures, the domes 15 are arranged in a cross-like configuration, because four beams 10a meet on the pillar 10b).

[0027] The interlocking coupling 18, as shown in Figure 6, can also have a play that allows translational settling movements after installation (see arrows 22).

[0028] The female coupling element 14 is constituted by a body 16, which is monolithic with the body of the beam 10a or applied thereto, and is shaped like an inverted cradle, which is complementary to the dome 15 and has a concave wall formed by a layer 17 of a material that can be attracted by the permanent magnet that constitutes the dome 15, for example ferromagnetic material.

[0029] This provides a stable coupling between the beam 10a and the pillar 10b, and the coupling can also allow slight settling movements (spherical joint, see arrows 19 and 20 in Figure 4 and the dashed lines 21, greatly exaggerated for the sake of clarity, of Figure 6), simply by acting on the size or type of the magnet and therefore on the attraction force it produces.

[0030] The shape of the coupling elements 13 and 14, instead of being hemispherical, can be shaped like half-disks and the female element can be arranged on the pillar 10b (in a cradle-like fashion) and the male element can be arranged on the beam 10a.

[0031] A body 10, in this case the pillar 10b, can be provided in its regions that are not occupied by the male coupling elements 13, the central region and the corner regions, with male coupling elements 13a of the same type with a dome made of permanent magnet, for mounting another post 10c provided with female coupling elements 14a of the same type as the already mentioned elements 14.

[0032] In practice it has been observed that the intended aim and objects of the present invention have been achieved.

[0033] Calculations of the axial load bearing capacity of the pillar (secured at one end) subjected to an axial load have in fact highlighted the advantages in terms of mechanical strength and weight (summarized in the table) of a beam having a body with a square cross-section (200 x 200 mm, 4 mm thickness of the layer 11, core 12 made of epoxy resin) having the structure according to the present invention over a beam having a body with a square cross-section (200 x 200 mm) made of reinforced concrete composed of the best cement (which according to the industry standard of concrete strength has a strength of 450 kg/cm²) with 20% 400-Mpa iron.

	Fiber cross-section (A1) cm ²	Resin cross-section (A2) cm ²	Concrete cross-section (A3) cm ²	Iron cross-section (A4) cm ²	Weight kg/m	Bearing capacity kg
Fiber pillar	31.36	368.64			49.568 (1)	1,172,480 (3)
Reinforced concrete pillar			320	80	208 (2)	464 (4)
% Difference in performance					23.83	252.69
Strength (R1 R2 R3 R4)	80 kg/mm ²	25 kg/mm ²	450 kg/mm ²	40 kg/mm ²		

$$(1) = (A1 \times L1 \times \delta1) + (A2 \times L1 \times \delta2)$$

$$(2) = (A3 \times L1 \times \delta3) + (A4 \times L1 \times \delta4)$$

$$(3) = (A1 \times R1) + (A2 \times R2)$$

$$(4) = (A3 \times R3) + (A4 \times R4)$$

(continued)

	Fiber cross-section (A1) cm ²	Resin cross-section (A2) cm ²	Concrete cross-section (A3) cm ²	Iron cross-section (A4) cm ²	Weight kg/m	Bearing capacity kg
Weight δ_1 δ_2 δ_3 δ_4 kg/dm ³	1.7	1.2	6.2	7.8		

$$(1) = (A1 \times L1 \times \delta_1) + (A2 \times L1 \times \delta_2)$$

$$(2) = (A3 \times L1 \times \delta_3) + (A4 \times L1 \times \delta_4)$$

$$(3) = (A1 \times R1) + (A2 \times R2)$$

$$(4) = (A3 \times R3) + (A4 \times R4)$$

where $L1 = 1\text{m}$

[0034] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0035] All the details may further be replaced with other technically equivalent elements.

[0036] In practice, the materials employed, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to requirements.

[0037] The disclosures in Italian Patent Application No. PD2001A000064, from which this application claims priority, are incorporated herein by reference.

[0038] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A supporting structure for erecting building constructions, **characterized in that** it is constituted by longitudinally elongated bodies, each of which comprises at least one outer layer made of carbon fiber impregnated with at least one epoxy resin.
2. The structure according to claim 1, **characterized in that** each one of said longitudinally elongated bodies has a core made of porous plastic material, which fills the space inside said at least one carbon fiber layer.
3. The structure according to claim 2, **characterized in that** said plastic material has an open-cell porous structure.
4. The structure according to claim 3, **characterized in that** said plastic material has a honeycomb structure.
5. The structure according to claim 2, **characterized in that** said core is made of epoxy resin.
6. The structure according to claim 1, **characterized in that** said at least one layer of carbon fiber is made of strands composed of filaments, of which at least one is made of metal and at least one is made of carbon fiber.
7. The structure according to claim 1, **characterized in that** the carbon fiber is interwoven with ceramic fibers.
8. The structure according to claim 1, **characterized in that** said impregnating epoxy resin, which also acts as an adhesive, is a resin that polymerizes at ambient temperature.
9. The structure according to claim 1, **characterized in that** said impregnating epoxy resin is a resin that is activated at a temperature that is higher than the ambient temperature if a heating chamber is available.
10. The structure according to one or more of the preceding claims, **characterized in that** complementary male and/or female coupling elements are rigidly coupled to the heads of said longitudinally elongated bodies.
11. The structure according to claim 10, **characterized in that** one of said male coupling elements is constituted by a dome made of permanent magnet, which is monolithic with, or applied to, the corresponding longitudinally elongated body.

12. The structure according to claim 10, **characterized in that** one of said female coupling elements is constituted by a cradle-like body, which is monolithic with, or applied to, the corresponding longitudinally elongated body, said cradle being shaped complementarily to said dome and having a concave wall formed by a layer made of a material that can be attracted by the permanent magnet that constitutes said dome.

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13. The structure according to one or more of claims 10 to 12, **characterized in that** said dome and said cradle are hemispherical.

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14. The structure according to one or more of claims 10 to 12, **characterized in that** said dome and said cradle are shaped like half-discs.

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15. The structure according to claim 10, **characterized in that** said male and female interlocking elements are rigidly coupled to the corresponding longitudinally elongated bodies in turn by interlocking and monolithic coupling by means of adhesives or the like.

16. The structure according to claim 10, **characterized in that** said male and female interlocking elements are rigidly coupled to the corresponding longitudinally elongated bodies so as to allow translational settling movements once installed.

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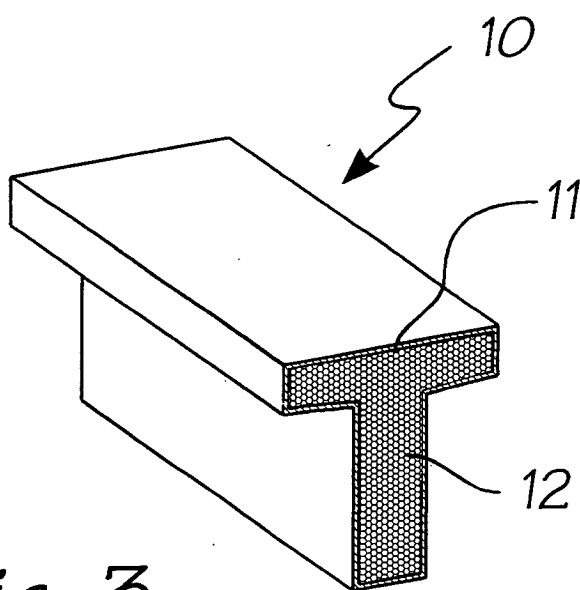
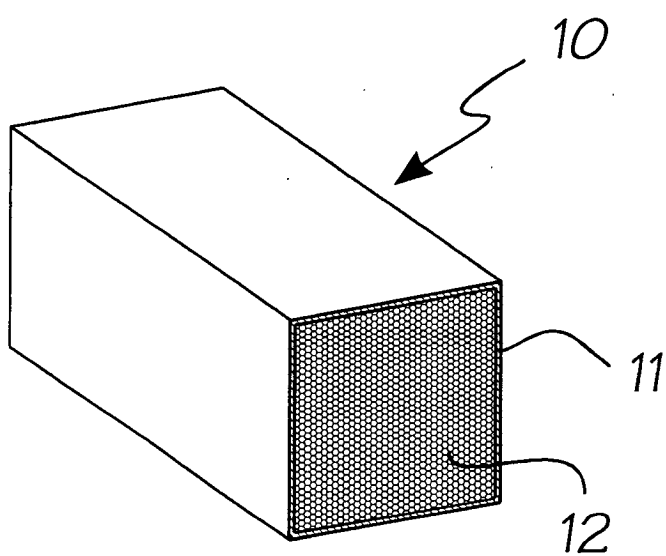
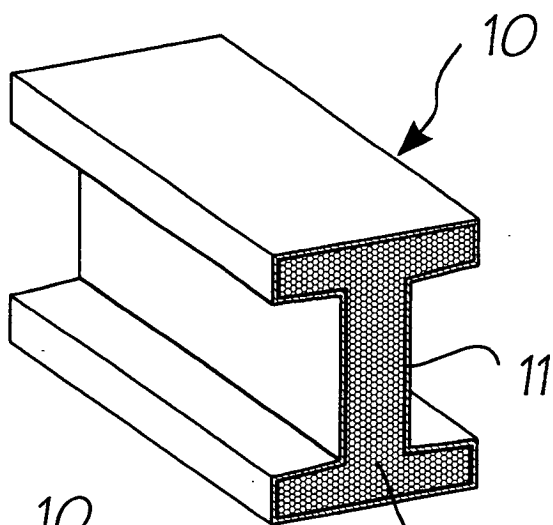
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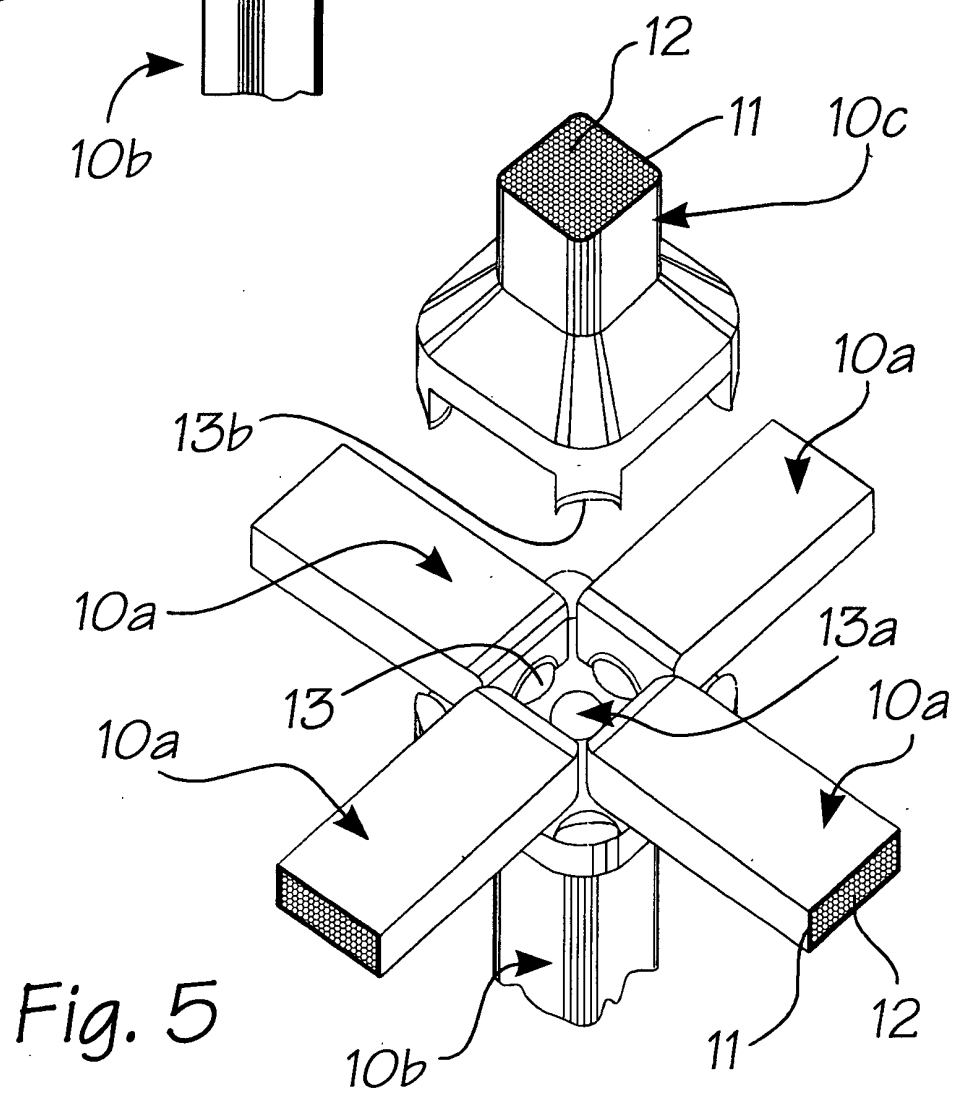
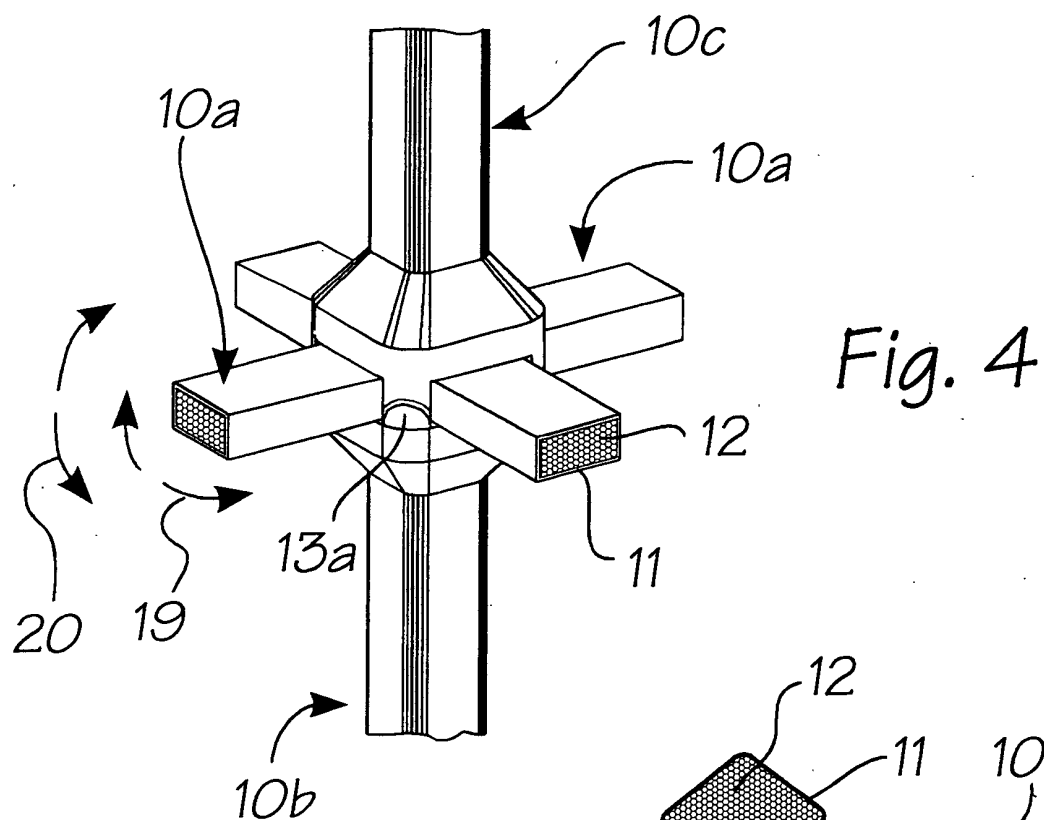
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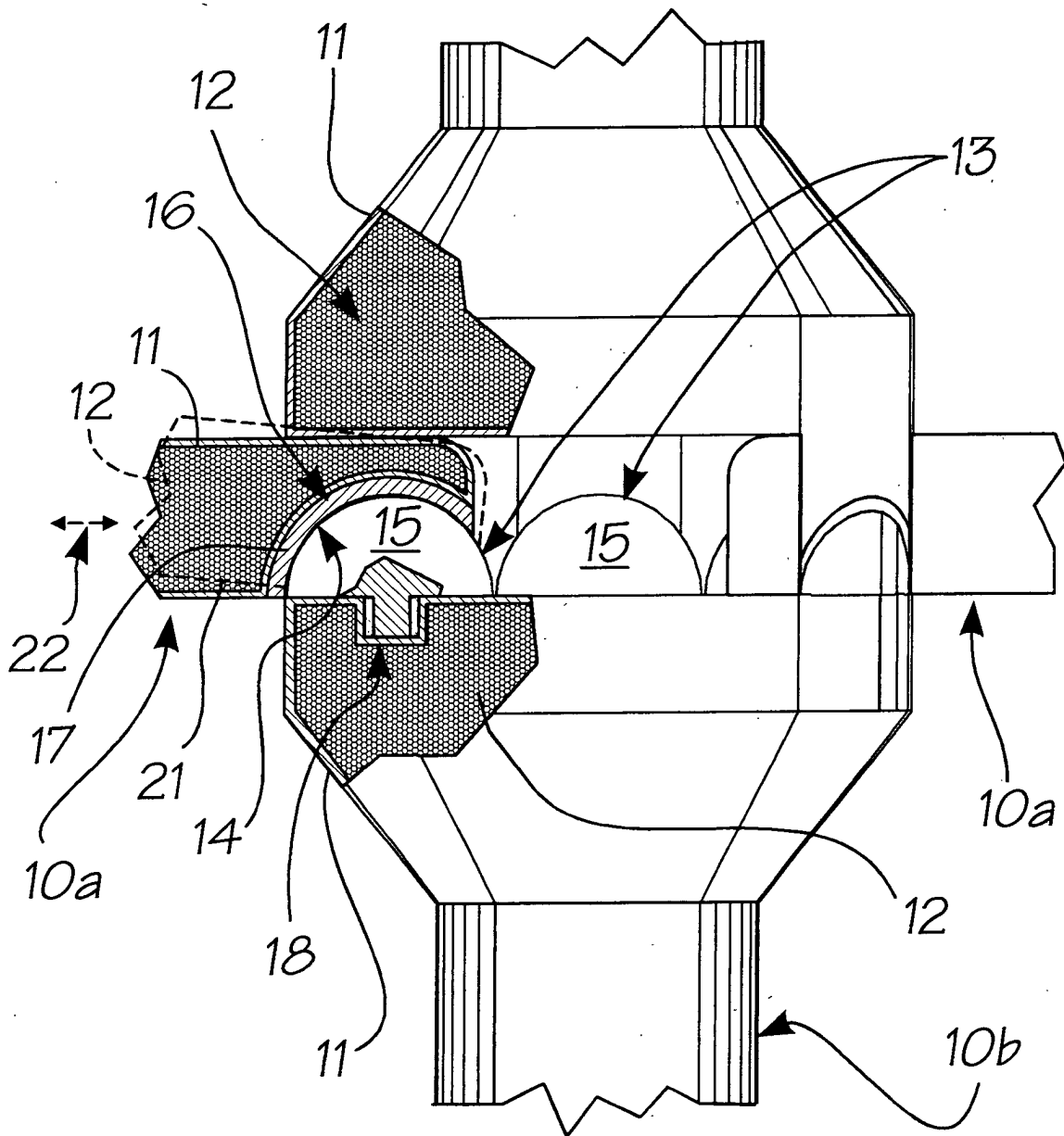
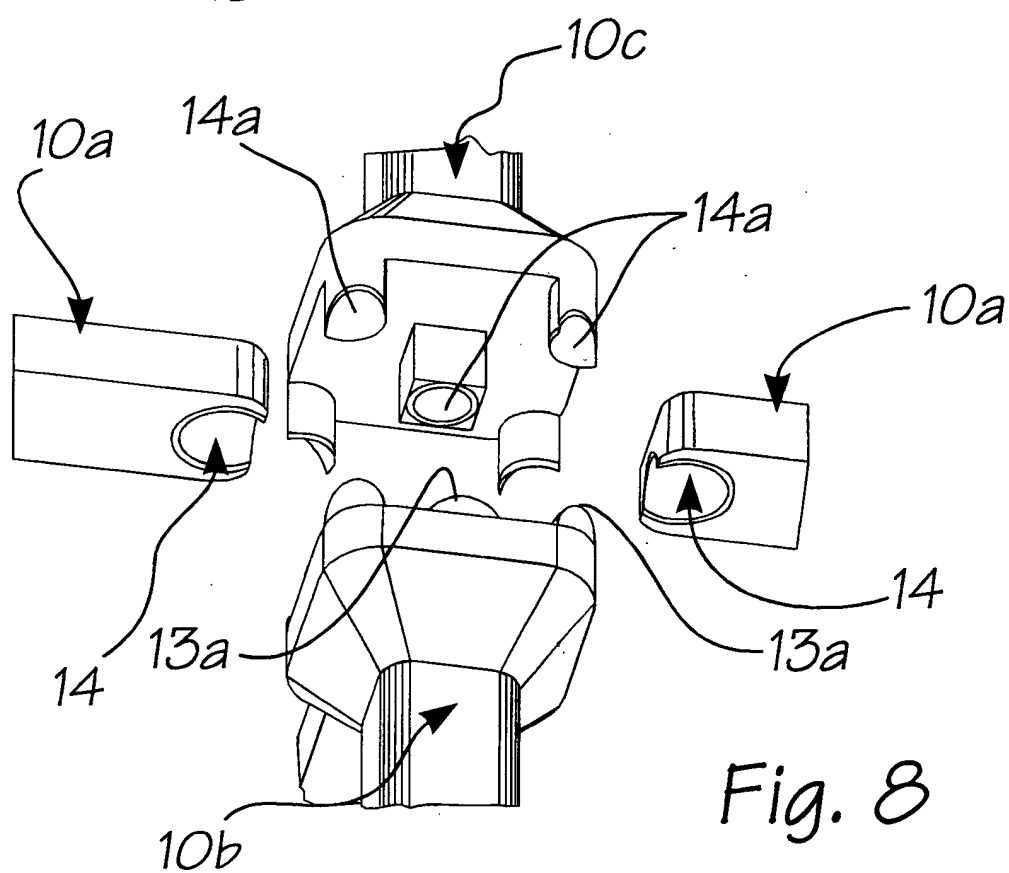
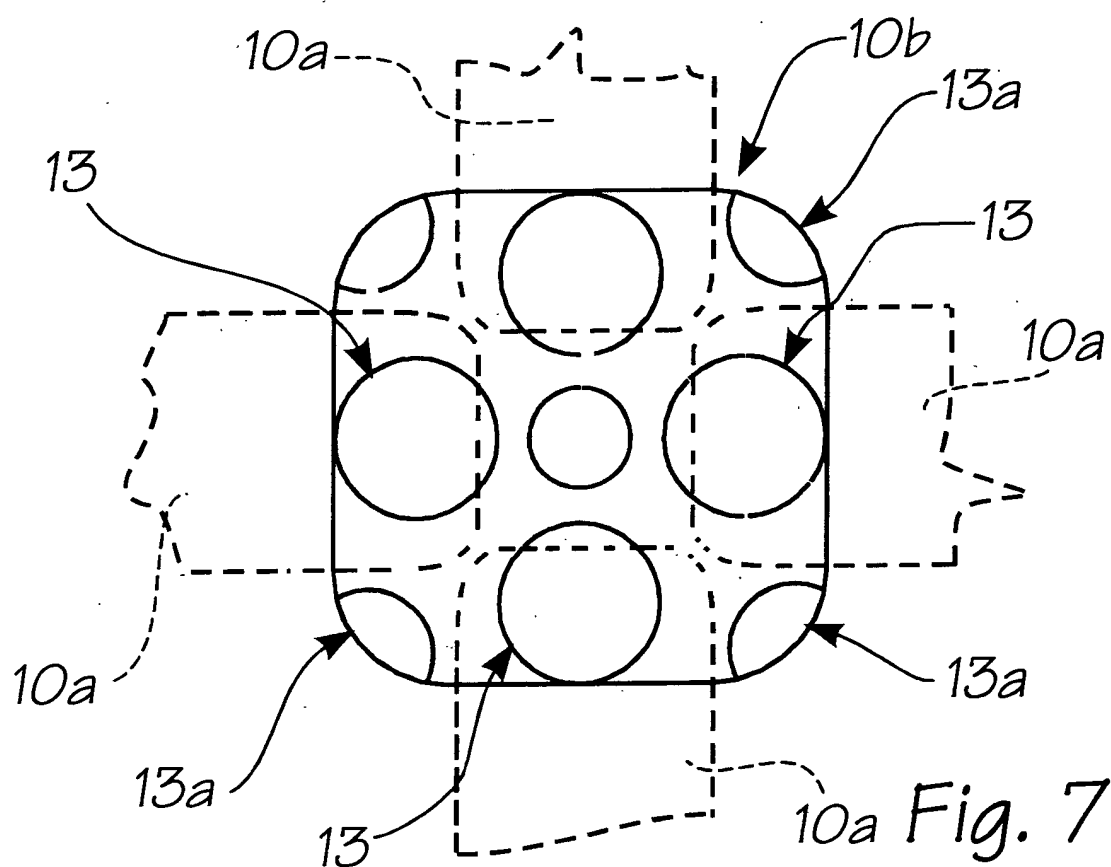


Fig. 6





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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 5342

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.7)
X	US 5 285 612 A (JOHNSON DAVID W) 15 February 1994 (1994-02-15) * the whole document *	1,2,10	E04C3/29 E04B1/14
X	US 4 020 202 A (KREFT HOLGER) 26 April 1977 (1977-04-26) * the whole document *	1,2	
X	EP 0 402 099 A (TORAY INDUSTRIES) 12 December 1990 (1990-12-12) * column 9 - column 16; figures 1-27 *	1,6	
X	GB 2 282 096 A (STANDARDS INST SINGAPORE) 29 March 1995 (1995-03-29) * claim 7; figures 1-4 *	1	
A		10	
X	US 5 080 943 A (CHULPSA OTTO) 14 January 1992 (1992-01-14) * the whole document *	1	
A		6	
A	US 3 100 555 A (ASHTON ALBERT A) 13 August 1963 (1963-08-13) * column 2; figures 1-4 *	1,10	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
X	US 4 177 306 A (SCHULZ RALF-THILO ET AL) 4 December 1979 (1979-12-04) * column 2 - column 3; figures 1-6 *	1	E04C E04B
A	US 5 704 185 A (LINDSAY PAT) 6 January 1998 (1998-01-06) * column 1-5 *	1,10	
A	US 5 285 613 A (JOHNSON DAVID W ET AL) 15 February 1994 (1994-02-15) * column 1; figures 1-20 *	1,10	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 26 August 2002	Examiner Festor, E
CATEGORY OF CITED DOCUMENTS		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	
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 02 00 5342

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-08-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5285612 A	15-02-1994	US 5024036 A	18-06-1991
		AU 7797691 A	07-01-1992
		WO 9119871 A1	26-12-1991
		US 5749198 A	12-05-1998
		US 5597629 A	28-01-1997
		US 5222344 A	29-06-1993
		US 5197818 A	30-03-1993
		US 5247774 A	28-09-1993
		US 5795424 A	18-08-1998
US 4020202 A	26-04-1977	DE 2334645 A1	16-01-1975
EP 0402099 A	12-12-1990	JP 2100097 C	22-10-1996
		JP 3008833 A	16-01-1991
		JP 8023095 B	06-03-1996
		DE 69003875 D1	18-11-1993
		DE 69003875 T2	05-05-1994
		EP 0402099 A2	12-12-1990
		US 5100713 A	31-03-1992
GB 2282096 A	29-03-1995	SG 47855 A1	17-04-1998
US 5080943 A	14-01-1992	DE 8907321 U1	28-03-1991
		AT 85770 T	15-03-1993
		AT 74189 T	15-04-1992
		CA 2019031 A1	15-12-1990
		CA 2019032 A1	15-12-1990
		DE 58901048 D1	30-04-1992
		DE 58903576 D1	25-03-1993
		EP 0403685 A1	27-12-1990
		EP 0403686 A1	27-12-1990
		US 5151144 A	29-09-1992
US 3100555 A	13-08-1963	NONE	
US 4177306 A	04-12-1979	DE 2622163 A1	24-11-1977
		ES 458963 A1	16-02-1978
		FR 2396645 A1	02-02-1979
		GB 1586184 A	18-03-1981
		IT 1076056 B	22-04-1985
		JP 1357456 C	13-01-1987
		JP 52140587 A	24-11-1977
		JP 61012781 B	10-04-1986
		JP 59176021 A	05-10-1984
US 5704185 A	06-01-1998	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

EP 02 00 5342

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26-08-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5285613 A	15-02-1994	CA 2154341 A1	05-08-1993
		US 5319901 A	14-06-1994
		WO 9315292 A1	05-08-1993
		US 5749198 A	12-05-1998
		US 5617692 A	08-04-1997

EPO FORM P0459

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