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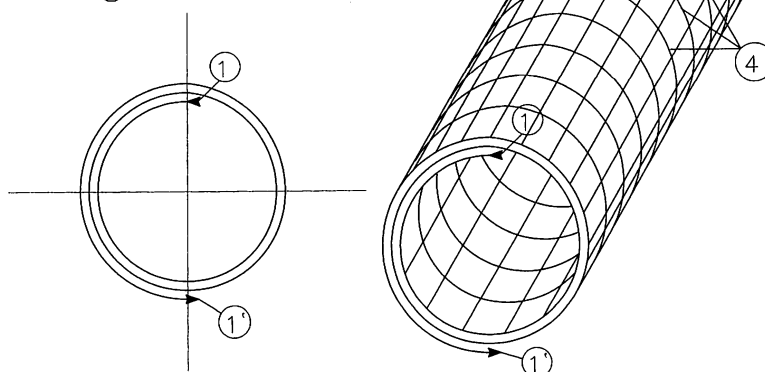
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(54) **BAR INCLUDING FIBRE-REINFORCED POLYMERS FOR CONCRETE REINFORCEMENT**

(57) The invention relates to a fibre-reinforced bar for reinforcing concrete, including at least: a first area (1) formed by a central core and consisting of glass fibre filament yarns or another type of reinforcement, which are affixed to one another using polymer resins; a second area (2) surrounding the first area and formed by rein-

forcing fabrics, preferably glass fibre, which second area, in addition to surrounding and forming a hoop around the first area, shields said first area against high temperatures; and a third area (3) comprising a granulate which is secured to the second area (2) using resins resistant to high temperatures.

Figura 4



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Description

Subject of the invention.

[0001] This invention describes a bar, normally of a circular type, intended for acting as a reinforcement in forming reinforced concrete, made by pultrusion with polymeric materials which have a good performance under compressive stresses and also stand up well to the effect of fire on items of concrete reinforced with this material.

Field of invention.

[0002] This invention is for application in the field of building in general and in particular in structures built by the sea, in structures subject to other aggressive agents, such as sewage treatment plants, petrochemical plants, in installations which require low electrical conductivity, such as conduits for electrical installations or in zones where low magnetic and radio-frequency permeability is needed, in which case its use is feasible through not causing shielding for communication and telephony equipment; and for all kinds of roads, railways, bridges and in general foundations for all kinds of constructions where the two main qualities of this material, such as *corrosion resistance and heat insulation* are required.

Background to the invention.

[0003] Plastics reinforced with fibres or composites were used for the first time in reinforcing reinforced concrete structures in the mid-nineteen-fifties and from then until now they have continued to be used as reinforcement systems in concrete structures. The development and improvement of the manufacturing methods means that other applications have emerged, such as their use for reinforcing concrete structures, which have been based on the experiments and results obtained from their use as structural reinforcement. This type of reinforcements, from the beginnings until now, have been carried out with the stratification of fabrics or through sticking plates or sheets of these materials onto the outer parts of the items to be reinforced.

[0004] The development of today's structural materials used in public works and building has, apart from their properties and characteristics, been marked by the economic cycles that have existed. Steel has played the leading role in different periods, but its vulnerability to fire, its increasingly high cost, which is growing higher through the great demand existing in emerging countries, along with other technical problems, such as corrosion, mean that this needs to be replaced in cases where this is required and possible.

[0005] Apart from this, the development of the pultrusion industry has gone along with the appearance of new products, first the development of the ones requiring as main characteristics of the material its uniformity, its mechanical strength and its electrical performance; later on

fields complementary to these were covered in which good performance was also necessary in aggressive atmospheres and it is now that it is beginning to be used in reinforced concrete structures for building in zones with a corrosive atmosphere, such as bridges and roadways in zones with a cold climate and large snowfalls or in marine or in seaside areas with a saline atmosphere. For many years more work has been done to protect steel reinforcements than to seek a replacement for these. They have been galvanised, protected with sprayed resin, with epoxy type resin, etc..., and it was not until the late nineteen-seventies that the advantages of bars made of resins reinforced with fibres as reinforcements for concrete were recognised. In the nineteen-eighties their use was developed in structures requiring special specifications, for example in bridges.

[0006] It should be stressed that in all the currently existing worldwide regulations on the use of these reinforcements in concrete structures there is never any reference on the calculation level to round bars pultruded with glass fibre being able to work under compression. Their use is not recommended and the formulation for this type of stress is not included either.

[0007] The loss of mechanical properties at high temperatures of bars made of resins reinforced with fibres for reinforcing concrete is another of the most important disadvantages involved, to enable their use in building. In comparison with steel some particular disadvantages of these items when exposed to high temperatures can be established:

- Loss of adherence between fibres: appearing through the performance of resins at high temperatures, the loss of adhesion causes on one hand a reduction in the mechanical capacity of round bars and other bars, and stops them from absorbing tangential tensions.
- A drop in strength and rigidity: both strength and rigidity drop as the temperature rises. Strength and rigidity drop drastically at temperatures of over 300°C due to the resin's failure to transmit stresses at high temperatures, depending on the type of resin to be used and the duration of the thermal load.

[0008] The adherence of composite bars with concrete is carried out by means of surface finishes with a view to both materials, concrete and composite bars, working in harmony. There are as a rule three types of surface finish for this type of round bar - corrugated, granular and granular - grooved.

[0009] From the state of the art it can be deduced that this type of bars has been used as a reinforcement for concrete since the late 20th century, with some advantages over using steel structures, but its use has not yet been applied, for the following conditioning factors:

- In supports and items under the prevalent action of compressive loads, for which this type of material is

not considered appropriate through the foreseeable buckling of the fibres.

- With the creation of a finish protecting the interior of the round bar from high temperatures in building and under fire loads.
- With a surface finish keeping the highest level of adherence under high temperatures.

Description of the invention

[0010] To palliate or eliminate the aforementioned problems the bar reinforced with fibres for reinforcing concrete is now being presented as subject of this invention patent.

[0011] The pultrusion bar or round bar intended to be used as reinforcement for concrete comprises at least three differentiated zones:

A first zone made up of a central core, formed of bundles of filaments of glass fibres or other type of reinforcements, stuck together by polymeric resins. A second zone surrounding and binding the first zone, made up in turn of reinforcement fabrics, preferably glass fibre, whose purpose, apart from binding the central core which it surrounds and envelops, is to shield the first zone from high temperatures. This fabric, as stated, is used for getting the greatest binding support, producing on one hand a surface heat shielding due to the greater amount of fibre existing in this zone, above all through the situation of the weft of the fabric, which acts as a fire protection mantle or protection for the central core of the first zone, protecting this thermally, enabling its use in usual parts of concrete, with its corresponding coatings intended to support the effect of fire loads.

A third zone formed by adding to the second zone a silica-based granulate of variable granulometry agglutinated by means of resins that stand up to high temperatures, which gives adherence to the bar with the reinforced concrete in which the bar is located as a reinforcement. For the adherence of this third zone to the second, the second zone has to be chemically stripped, to get rid of the formwork removal agents, without damaging the fabrics existing in this.

[0012] The bar intended for working under compression and under the effect of fire loads is made by means of the fabric which is located in the second zone, which manages to bind together the fibres of the longitudinal reinforcements of threads or bundles of fibres located in the first zone, preventing the possibility of local buckling of the fibres in turn due to the larger amount of fibres existing in this second zone and the situation of the weft of the fabric, ensuring thermal protection of the central core which gives it greater strength under the effect of external heat loads.

Brief description of the figures.

[0013] We now go on to describe very briefly a number of drawings which help to understand the invention better and which are expressly associated with an embodiment of this invention being presented as a non-limiting example of this.

Figure 1 represents a longitudinal section of a bar reinforced with fibres for reinforcing concrete, as the subject of this invention.

Figure 2 represents the cross-section of a bar reinforced with fibres for reinforcing concrete, as the subject of this invention.

Figure 3 represents a view of one of the finishes of the bar, in which one can observe that this is made up of two types of fabric -1-1' and 2-2', arranged in such a way that these form a mesh of glass covering the whole surface, acting as a mantle and providing a band to bind the longitudinal fibres existing in the central zone.

Figure 4 represents a view of another finish of the bar reinforced with fibres, which in this case is made up of a single fabric which envelops the central core in a dual layer.

Preferential embodiment of the invention.

[0014] As can be seen in Figure 1, the fibre-reinforced bar for reinforcing concrete covered by this invention consists at least of:

A first zone (1) formed of a central core, consisting of threads or bundles of longitudinal filaments of glass fibres or some other type of reinforcement, stuck together by polymeric resins.

A second zone (2) which envelops the first zone, formed of reinforcement fabrics, preferably bundles of filaments of glass fibre which, apart from enveloping and binding the first zone, shield the first zone against high temperatures.

A third zone (3) formed by adding a granulate secured to the second zone (2) by means of resins, giving adherence to the bar with the reinforced concrete in which the bar is fitted as reinforcement;

[0015] Figure 2 shows the cross-section of the bar reinforced with fibres for reinforcing concrete covered by this invention.

[0016] Figure 3 represents one of the types of finish of the second zone (2) where the finish is made by means of two fabrics (1 and 1') and (2 and 2'), where the first of these rotates anti-clockwise. In this same figure one can see the relative situation of the weft (4) and the warp (3) in these fabrics, where the warp (3) lies in parallel to the bundles of glass fibre and the weft (4) is normal to these. Although the representation is schematic, the type of fabric used is a taffeta, with a weft whose filaments have the

same width as that of the warp (3) and which beside this cover the whole surface in several layers, acting practically as a glass fibre mantle and ensuring the binding of the bundles in the first zone (1) by means of the weft.

[0017] Figure 4 represents another type of finish of the second zone (2) of Fig. 1), similar and with the same functions as the one indicated in Figure 3, although using a single fabric which envelops the central core (1) of Fig. 1) in a double layer, ensuring greater transversal coercion in this case.

Claims

1. A bar based on polymers reinforced with fibres for reinforcing concrete, **characterised by** comprising at least:
 - a first zone (1) made up of a central core, consisting of bundles of glass fibres or some other kind of reinforcement, stuck together by polymeric resins.
 - A second zone (2) which surrounds the first zone, formed of reinforcement fabrics, preferably of glass fibre, which envelop and bind together the first zone, preventing local buckling of the glass fibre bundles of the first zone.
 - A third zone (3) formed by adding a granulate secured by means of resins withstanding high temperatures to the third zone (2).
2. A bar reinforced with fibres for reinforcing concrete, according to claim 1, **characterised in that** the reinforcements of the first zone are threads of glass fibre filaments.
3. A bar reinforced with fibres for reinforcing concrete, according to claim 1, **characterised by** the second zone (2) acting as a glass mantle shielding the first zone (1) from high temperatures.
4. A bar reinforced with fibres for reinforcing concrete, according to claim 1, **characterised in that** the third zone (3) gives adherence to the bar with the reinforced concrete in which the bar is fitted as a reinforcement, withstanding high temperatures through using silica granules stuck with resins withstanding high temperatures.

Figura 1

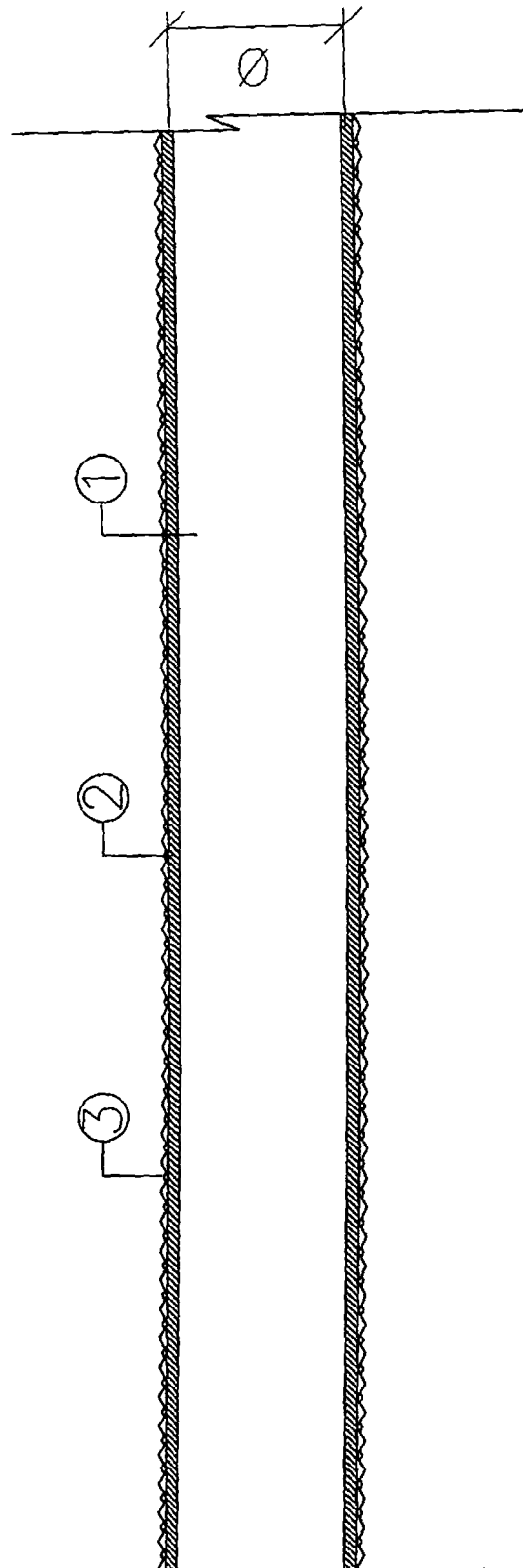
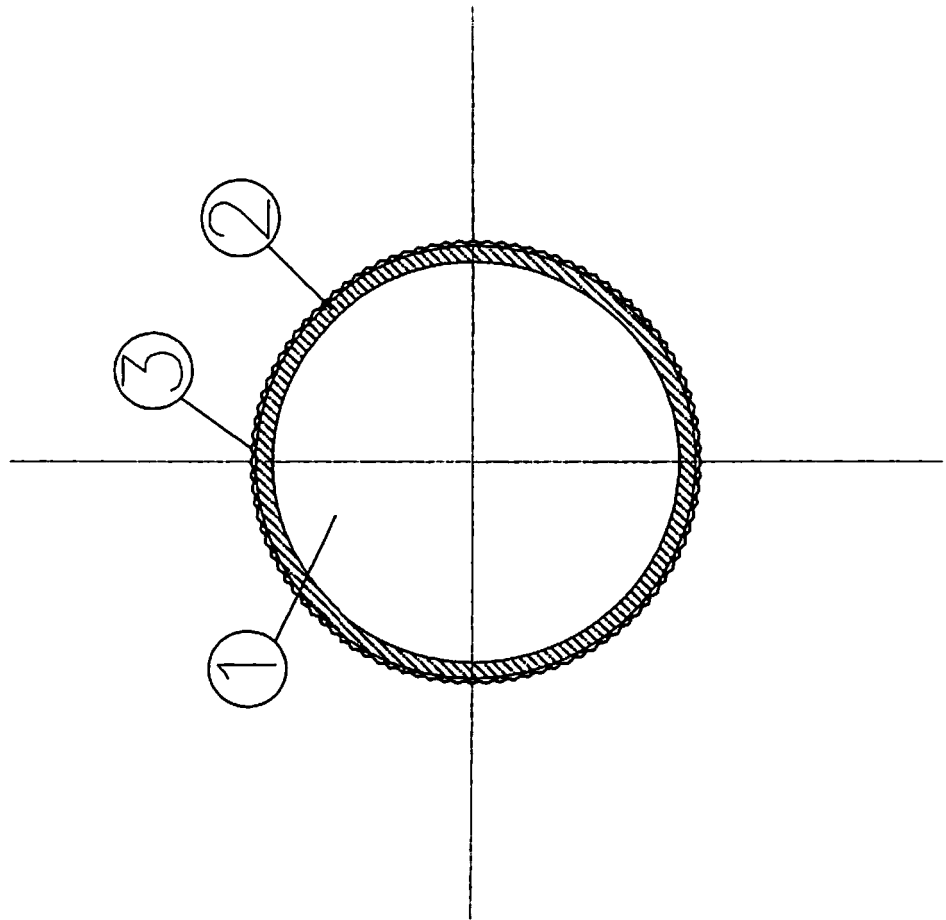


Figura 2



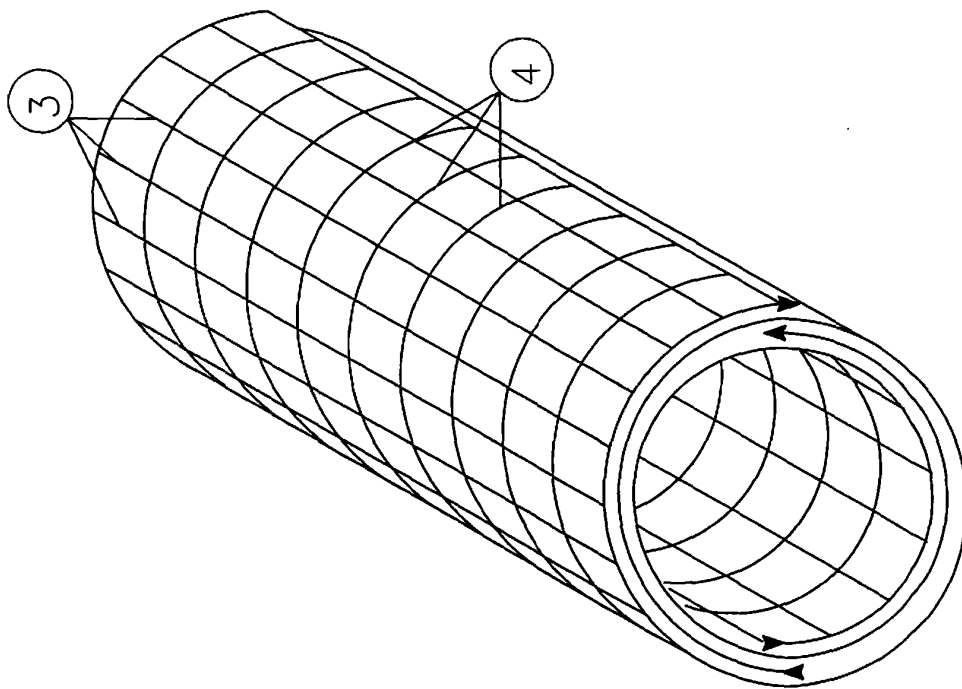
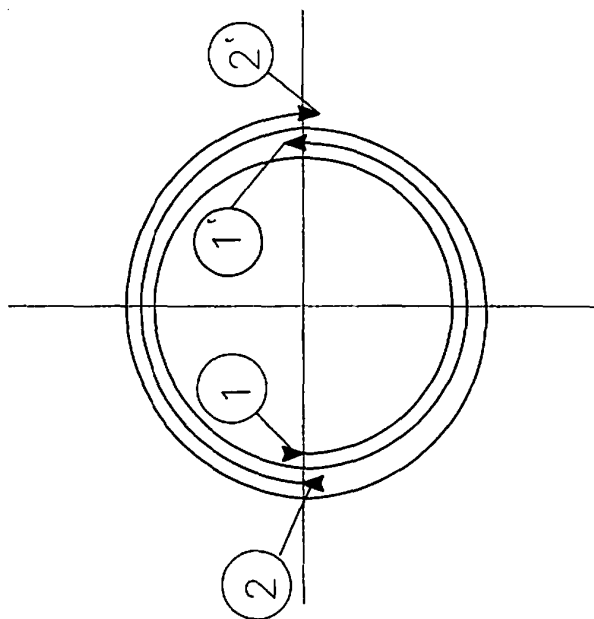


Figura 3



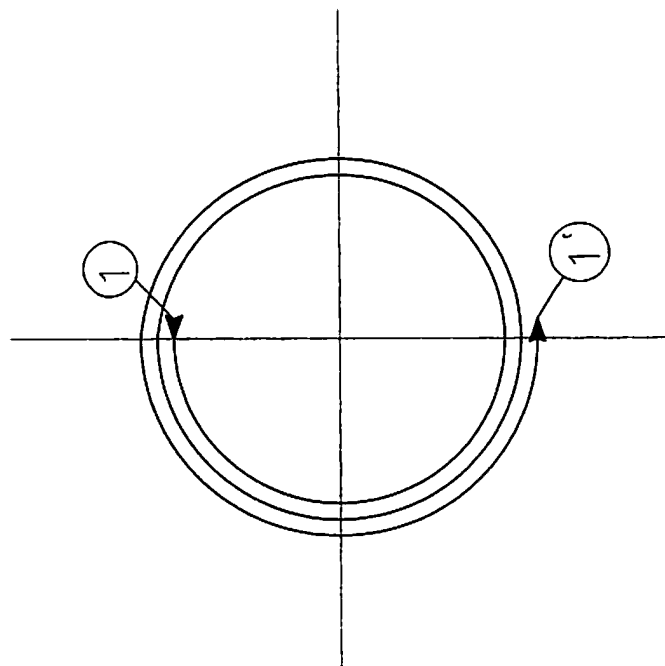
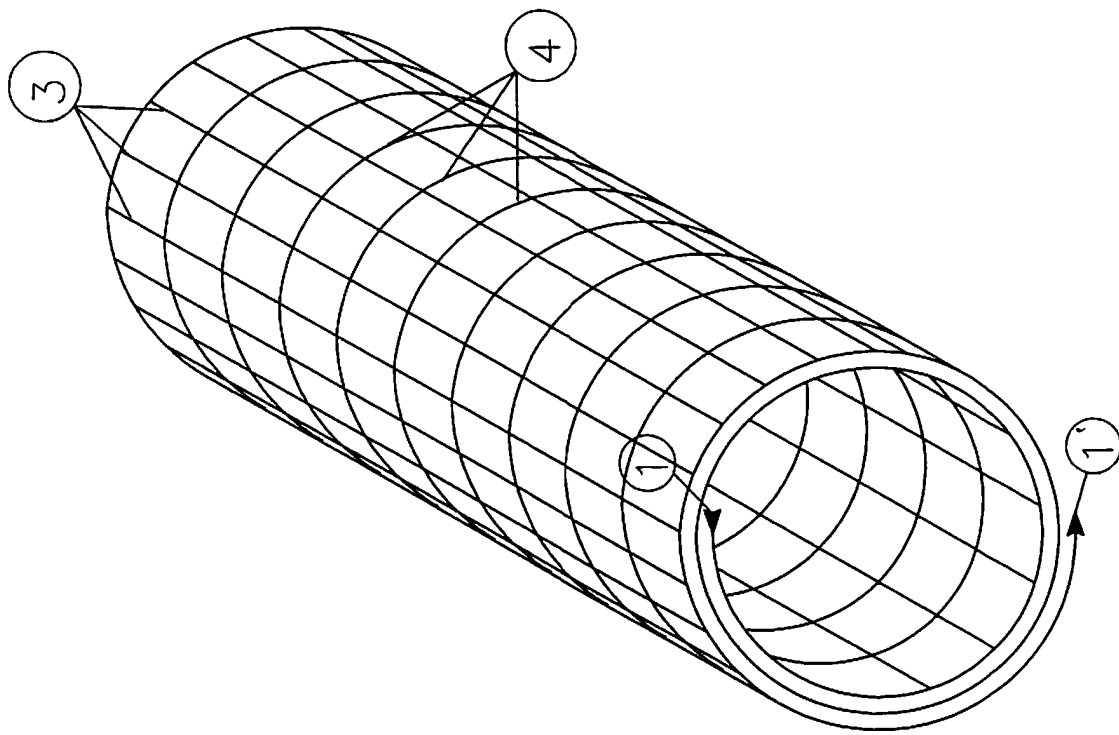


Figura 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2009/070031

A. CLASSIFICATION OF SUBJECT MATTER

E04C 5/07 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04C5+

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

INVENES,EPODOC,WPI,PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6174595 B1 (SANDERS et al.) 16.01.2001, Description, figures 1 and 2	1-4
X	WO 2005068743 A1 (RE FORM SYSTEM CO LTD ; LEE SANG KEUN) 28.07.2005, Page 3 line 4 - page 9 line 17, figure 3B	1-4
A	WO 2006038225 A2 (PATWA SAURABH S) 13.04.2006, the whole document	1-4
A	WO 2007036058 A1 (EIDGENOESSISCHE MATERIALPRUEFU ; FIBROTEC AG ; KAUFMANN JOSEF) 05.04.2007, the whole document	1-4
A	ES 1056301 U (POLYMEC SL) 16.03.2004, the whole document	1-4

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance.		
"E" earlier document but published on or after the international filing date		
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"O" document referring to an oral disclosure use, exhibition, or other means	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other documents, such combination being obvious to a person skilled in the art
"P" document published prior to the international filing date but later than the priority date claimed		
	"&"	document member of the same patent family

Date of the actual completion of the international search

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Form PCT/ISA/210 (second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/ ES 2009/070031

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