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

(11) EP 0 785 317 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
23.07.1997 Bulletin 1997/30

(21) Application number: **96904103.7**

(22) Date of filing: **01.03.1996**

(51) Int. Cl.[6]: **E04C 5/06**, E04C 5/16

(86) International application number:
PCT/ES96/00044

(87) International publication number:
WO 96/27062 (06.09.1996 Gazette 1996/40)

(84) Designated Contracting States:
BE DE DK ES FR GB GR IE IT NL PT SE

(30) Priority: **02.03.1995 ES 9500414**
30.03.1995 ES 9500637
26.01.1996 ES 9600182

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(54) METHOD FOR DIMENSIONING REINFORCEMENT ELEMENTS FOR REINFORCED CONCRETE BEAMS

(57) Method for dimensioning and constructing reinforcement elements for beams and pillars of reinforced concrete, consisting in dimensioning independently the horizontal and vertical branches of the transverse reinforcement element, in replacement of the adapters used heretofore, and making possible the prefabricated construction of any reinforcement element for reinforced concrete, with an important saving in materials and in space necessary for storing the constituents of the reinforcements for reinforced concrete.

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Description

Until now, the reinforcement for reinforced concrete beams has been calculated in terms of width, height, length and the number and diameter of upper bars, which are generally the same length as the beam, and by the number and diameter of the bottom lengthwise bars, some of which may be the same length as the beam, and others, the so-called strengthening bars, which may be shorter. A beam also has stirrups, defined by their width and height, the number of vertical sections, the diameter of the bars with which they are made, and their spacing.

Both the diameter and the number of vertical sections and the spacing between stirrups may alter along the beam: in general, diameters are greater and the numbers of vertical sections largest, with the shortest spacing, close to the beam end rather than in the centre. By way of example, and without limitation, standard reinforcement for a reinforced concrete beam may have several top lengthwise bars, several bottom lengthwise bars of the same length as the so-called strengthening bars, and the stirrups, which may be of several vertical sections of variable width, height and spacing. The bar diameter may be any of those in the usual range for construction though, normally, the upper bars are between 6 and 12 mm and the lower bars between 8 and 25 mm, while the stirrups are between 6 and 12 mm.

Beam reinforcement is dimensioned to meet the conditions imposed by the design calculation also taking account of the construction of its component elements. The design of the stirrups, whether in manual equipment or automatic programmable machines, means that the upper and lower horizontal sections of the transversal reinforcements must have the same diameter and spacing as the vertical sections when, for calculation purposes, they can be of a smaller diameter and significantly more spaced than the vertical sections. The technology familiar until now is thus rendered obsolete, given the novelty of this invention described below. Nothing similar has been known until now and it involves major savings of materials and the possible prefabrication of reinforcement, with great space saving. Therefore, in this method, we propose dimensioning of the vertical and transversal reinforcement and of the upper and lower horizontal sections independently, to provide a significant saving in the materials used to manufacture reinforcements.

The concept of independent dimensions for the vertical and horizontal sections of the transversal reinforcement leads into a description of the main components of this invention.

The main elements of the reinforcement for reinforced concrete beams and pillars based on the foregoing dimensioning procedure are: a sub-reinforcement known as the grill, and the upper and lower horizontal bars of the transversal reinforcement.

The reinforcement is designed as a set of sub-reinforcements each comprising a top and bottom bar welded together or attached by any other means by a number of vertical sections. Known as grills, these sub-reinforcements are linked by the top and bottom horizontal sections of the transversal reinforcement, which is generally of a smaller diameter than the vertical sections of the grills, and more spaced in the case of reinforcement for reinforced concrete beams.

The reinforcement is completed with the bottom bars, some of which are as long as the beam and others which are shorter than the beam: these are the so-called strengthening bars. See figures 1 and 2 for a better understanding of the foregoing.

The concrete beam reinforcement comprises the grills 1-1'-1R, 2-2'-2R, and 3-3'-3R which have a top bar and a bottom bar and several vertical sections joined by the upper horizontal bars Hs and lower horizontal bars Hi, along with two bottom bars the same length as the beam, nos. 4 and 5, and a bottom strengthening bar -6- of length l.

With this design for the beam reinforcement, the vertical sections of the transversal reinforcement are made independent of the horizontal sections, and the diameter and spacing of the vertical sections can be combined to optimize the use of the materials. Moreover, because the horizontal bars Hs and Hi are independent of the vertical sections, they can be of a smaller diameter and more separated, with the resulting saving of materials.

This shows how the reinforced concrete beam reinforcement consists of sub-reinforcements (grills) with long and short reinforcing longitudinal bars, and top and bottom transversal bars. The construction system based on the above dimensioning method eliminates the traditional stirrups, and the notion of sub-reinforcement (grill) emerges.

Sub-reinforcement (grill) is the link between a top and bottom lengthwise bar by means of several vertical transversal bars (see Figs. 3 or 4 by way of illustration, without limitation).

With the adequate spacing of the number of grills required according to the calculation to withstand shear strength, the width of a beam, B, is obtained. A grill of height H and Length L can be used to form beams of any width. In addition, the diameters of the top and bottom bars of the grill and the transversal bars vary only slightly for beams of Length L, meaning that the grills can be prefabricated, taking up very little space.

The upper and lower horizontal bars of the transversal section are the other necessary elements for the construction of the beams; their length normally varies by 5 cm steps, as the width of the beams and pillars and the usualy diameters are 6 and 8 mm. They can thus be made in high-performance automatic straightener-cutter machinery and stored in very limited space. This invention proposes the concept of constructing the reinforcement for reinforced concrete beams and pillars using pre-fabricated elements stored in a small space and making it possible to combine them to form all types of reinforcement for reinforced concrete beams and pil-

lars quickly and economically. These basic components are as follows: the sub-reinforcement known as the grill, and the top and bottom bars of the transversal reinforcement. By adding to these components the free lengthwise bars which can be the same length as or shorter than the beam it is possible to make any reinforcement for reinforced concrete beams and pillars, taking advantage of the savings of materials which this dimensioning method allows, as well as the versatility, speed and space-saving afforded by pre-fabrication.

In a variant of the so-called grill sub-reinforcement, as in figures 7 and 8, the transversal bars are placed over rather than between the lengthwise top and bottom bars and are welded together or joined by any other means.

This modification facilitates automatic production of the sub-reinforcement or grill.

A further improvement to this variant consists of the replacement when convenient for the calculation or production of the top and bottom transversal reinforcement by the sub-reinforcement or grill defined in figures 7 and 8, making it possible to construct the reinforcement for reinforced concrete beams and pillars as indicated in figures 5 and 6, by a combination of sub-reinforcement (grills) 1-1'-1R, 2-2'-2R, and 3-3'-3R placed in the vertical position, with other sub-reinforcement (grills) 4-4'-Hs -5-5'-Hi placed horizontally and welded together or joined by any other means. By way of example and without limitation, the reinforcement is completed with the long free bottom bars 6 and 8 and the short free bar 7 (see figures 5 and 6).

Another variant of the sub-reinforcement known as grills in figures 9 and 10 is differentiated from the grills described above in that the transversal bars are joined to the longitudinal bars by welding or by any other means, and all or some of them are bent over the longitudinal bars to form a hook.

This modification provides greater strength to the connection of the transversal bars, with the lengthwise components of the sub-reinforcement (bars) where and when necessary to the calculation: the strength of the welding is added to that of the hook in its anchoring in the concrete.

These sub-reinforcements, with all or part of the transversal bars ending in a hook, can be used vertically (figures 9 and 10), or horizontally at the top or bottom (figures 11 and 12), or combined with similar or different sub-reinforcement such as those described above, or else with the horizontal transversal reinforcement also described.

By way of illustration and without limitation, a reinforced concrete beam reinforcement is drawn (figures 13 and 14) combining the sub-reinforcement described according to figures 9 and 10, in the vertical position 1-1'-1R, 2-2'-2R, and 3-3'-3R, with the sub-reinforcement described according to figures 7 and 8 placed horizontally at the bottom 4-4'-Hi and with the free horizontal bars in the top horizontal position Hs.

The reinforcement is completed, by way of example and without limitation, with the bottom lengthwise bars 5 and 6.

Claims

1. A method for dimensioning reinforcements for reinforced concrete beams wherein calculation of the vertical sections of of the transversal reinforcement is made independent of that of the top and bottom horizontal bars, providing major savings of materials.

2. A procedure for the construction of reinforcements for reinforced concrete according to claim 1, which replaces traditional stirrups with independent vertical and horizontal bars which may thus be of different diameters and spaced at different distances along the length of the reinforcement.

3. A procedure for the construction of reinforcements for reinforced concrete according to claims 1 and 2, which defines the top and bottom horizontal bars of the transversal reinforcement which may be valid for any reinforcement of beams or pillars made of reinforced concrete of width B, and can be produced in automatic machinery and stored in very limited space.

4. A procedure for the construction of reinforcements for reinforced concrete acording to claim 2, which defines sub-reinforcements known as grills formed by a top and bottom bar of any diameter linked together by welding or by any other means, and vertical bars of any diameter separated by spaces which may vary along the reinforcement. The length of these transversal bars is defined by the height of the reinforcement.

5. A procedure for the construction of reinforcements for reinforced concrete according to claims 3 and 4, wherein reinforcement is formed with a number of sub-reinforcements (grills) defined in the calculation, and suitably separated. Said sub-reinforcements are joined by the top and bottom transversal bars defined in claim 3, spaced along the reinforcement as required according to the calculation. The reinforcement is completed with the addition and attachment, by welding or some other means, of the top free lengthwise bars to the top transversal bars, and the free, long and reinforcing bars to the bottom transversal ones.

6. A procedure for the construction of reinforcements for reinforced concrete as set forth in claims 2 and 4, wherein sub-reinforcements, known as grills, are defined in the form of two lengthwise bars, one at the top and the other at the bottom, on which transversal bars are fitted, attached to the former by welding or by any other means.

7. A procedure for the construction of reinforcements for reinforced concrete as set forth in claims 1, 2, 3, 4, 5 and 6, wherein the reinforcements are made by a combination of sub-reinforcements placed vertically, with other sub-reinforcements placed horizontally, and joined by welding or by any other means. The reinforcement is completed with the addition and attachment, by welding or by any other means, of the top free lengthwise bars to the top horizontal sub-reinforcement, and the bottom long free and reinforcement lengthwise bars to the bottom horizontal sub-reinforcement.

8. A procedure for the construction of reinforcements for reinforced concrete as set forth in claims 2, 4, and 6, wherein the transversal bars of the sub-reinforcement or grill are attached by the longitudinal bars by welding or by any other method, and all or some of them are bent over the longitudinal bars to form a hook, and can be employed either vertically or horizontally.

9. A procedure for the construction of reinforcements for reinforced concrete as set forth in claims 1, 2, 3, 4, 5, 6, 7 and 8, wherein said reinforcements for reinforced concrete beams and pillars can be made using any combination of the sub-reinforcements described in the previous claims, with free horizontal bars as described in claim 2, completed with the top and bottom lengthwise bars.

10. A procedure for the construction of reinforcements for reinforced concrete as set forth in claims 1, 2, 3, 4, 5, 6, 7, 8 and 9, proposing the pre-fabrication of the sub-reinforcements (grills) and of the top and bottom transversal bars, which can thus be stored in a more limited space than that taken up by the reinforcements they can be used to construct with.

11. A procedure for the construction of reinforcements for reinforced concrete as set forth in claims 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10, wherein the reinforced concrete beam and pillar reinforcements are designed using the dimensioning method in claim 1 and the construction methods in claims 2, 3, 4, 5, 6, 7, 8 and 9, making it possible to construct the reinforced concrete beam and pillar reinforcements with more economical use of the materials, and more quickly, thanks to the versatility and generic nature of the elements described in claims 2, 3, 4, 5, 6, 7, 8 and 9.

Amended claims under Art. 19.1 PCT

1.- Method for dimensioning the reinforcement for reinforced concrete beams whereby calculation of the vertical sections of the transversal reinforcement is made independent, enabling a procedure for the construction of reinforcement for reinforced concrete defining sub-reinforcements named grills, used mainly resist the cutting stress, formed by an upper bar and lower bar of any diameter, welded together or joined by any other means with vertical bars of any diameter which are spaced apart by a distance which may vary along the length of the reinforcement. The length of said transversal bars is defined by the height of the reinforcement.

2.- Method for constructing reinforcement for reinforced concrete according to claim 1 characterised by the formation of a reinforecement by the number of sub-reinforcements (grills) defined by the calculation, spaced by the appropriate distance. Said sub-reinforcements are joined by upper and lower transversal bars spaced along the length of the reinforcement by the distance indicated by the calculation. The reinforcement is completed with the addition and welding or attachment by any other means of the upper free longitudinal bars to the upper transversal reinforcements and the free, long, reinforcing longitudinal bars to the lower transversal reinforcements.

3.- Method for constructing reinforcement for reinforced concrete according to claim 1 characterised by defining sub-reinforcements, named grills, consisting of two longitudinal upper and lower bars over which transversal bars are fitted and attached to them by welding or by any other means.

4.- Method for constructing reinforcement for reinforced concrete according to claims 1, 2 and 3 characterised by constructing said reinforcement with a combination of subreinforcements fitted vertically with other sub-reinforcements fitted horizontally, and joined together by welding or by any other means. The reinforcement is completed with the addition and welding or attachment by any other means of the upper free longitudinal bars to the upper horizontal sub-reinforceinent and the lower free, long, reinforcing longitudinal bars to the lower horizontal sub-reinforcement.

5.- Method for constructing reinforcement for reinforced concrete according to claims 1 and 3, characterised because the transversal bars of the sub-reinforcement known as grills are joined to the longitudinal ones by welding or by any other means, and all or some of them are bent over the longitudinal bars to form a hook, and they can be used both vertically and horizontally.

6.- Method for constructing reinforcement for reinforced concrete according to claims 1, 2, 3, 4 and 5, characterised because the reinforcements for reinforced concrete beams and pillars can be constructed using any combination of the sub-reinforcements described in the foregoing claims,

using individual horizontal bars completed with the upper and lower longitudinal bars.

7.- A method according to claims 1, 2, 3, 4, 5, and 6 characterised by the pre-fabrication of the sub-reinforcements (grills) and of the upper and lower transversal bars, enabling them to be stored in a reduced space when compared with that required for the reinforcements that can be constructed with them.

8.- A method according to claims 1, 2, 3, 4, 5, 6 and 7, characterised by design of the reinforcements for reinforced concrete beams and pillars taking account of the dimensioning method and the construction procedures in claims 1, 2, 3, 4, 5 6 and 7, enabling construction of the reinforcements for reinforced concrete beams and pillars making more economical use of the materials, and more quickly, thanks to the versatility and generality of the elements described in claims 1, 2, 3, 4, 5, 6 and 7.

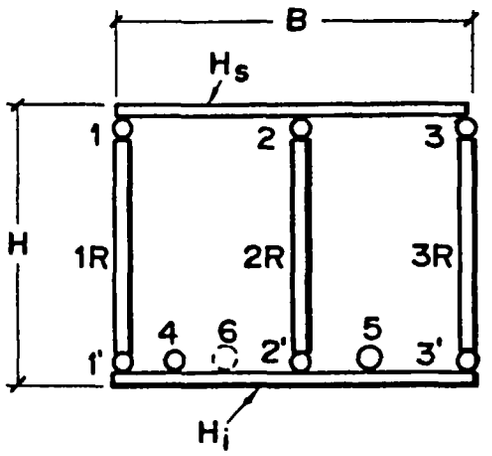

FIG. 1

FIG. 3

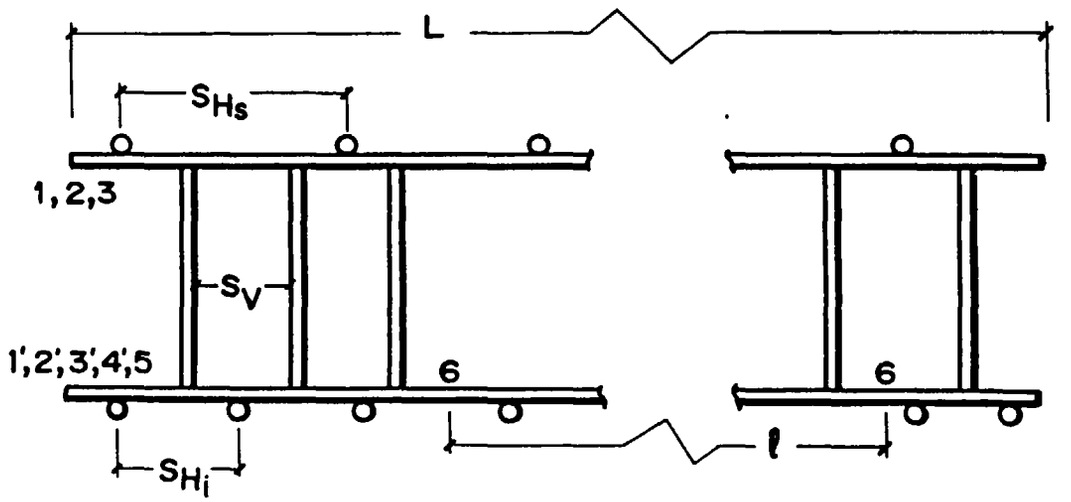

FIG. 2

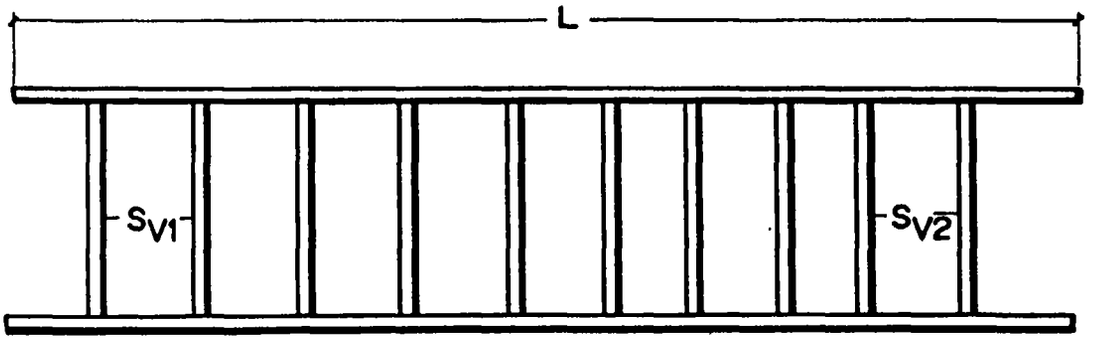

FIG. 4

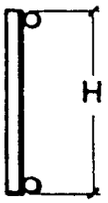

FIG.7

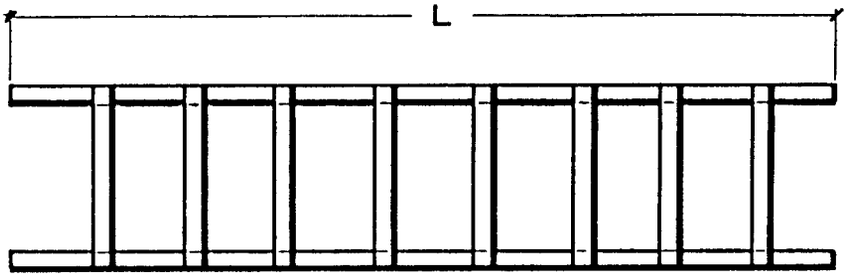

FIG.8

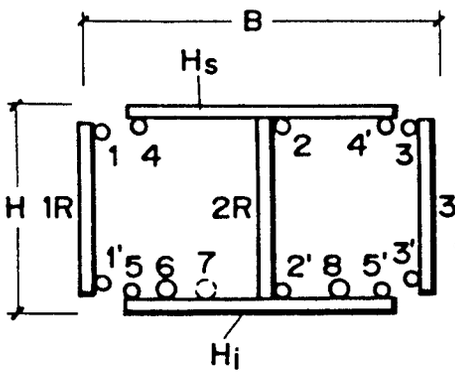

FIG.-5

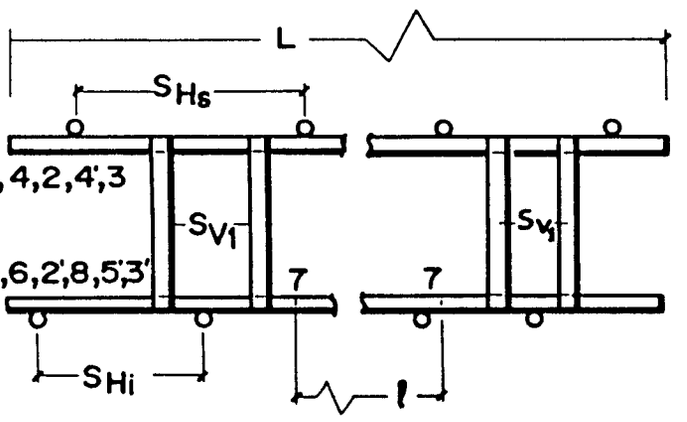

FIG.-6

FIG. 9

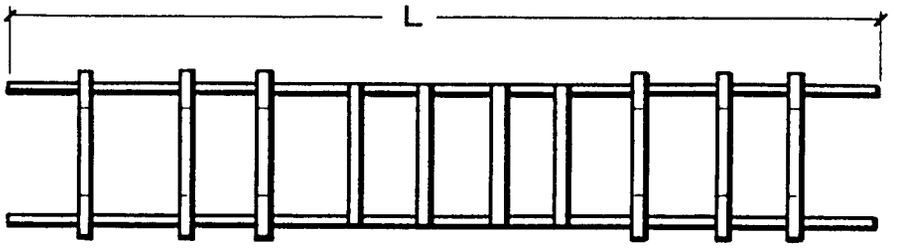

FIG. 10

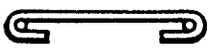

FIG. 11

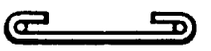

FIG. 12

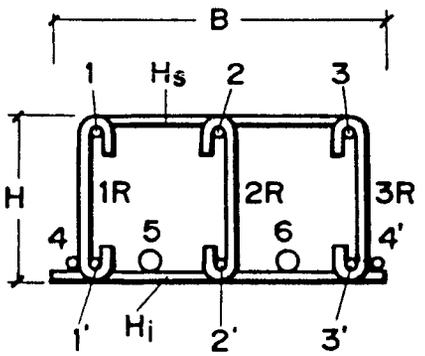

FIG. 13

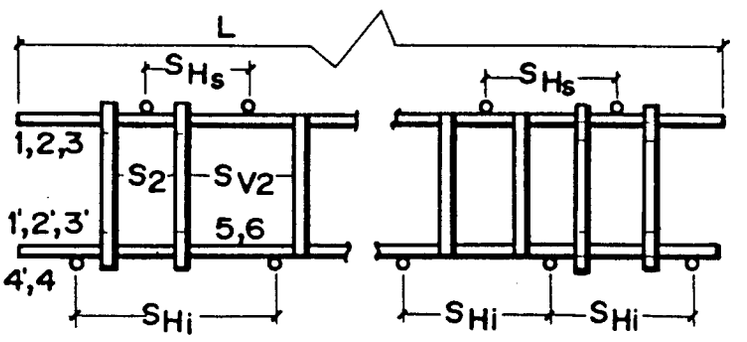

FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES 96/00044

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E04C5/06 E04C5/16

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)

IPC6: E04C

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE,B,12 96 773 (BADISCHE STAHLWERKE) 4 June 1969 (04.06.69) see column 1, line 1- column 1, line 7 see column 2, line 55- column 3, line 3 see column 3, line 39- column 3, line 57 see column 4, line 22- column 4, line 36 see figures 1-7 ---- -/--	1,2

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

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"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 such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 1996 (29.05.96)	30 May 1996 (30.05.96)
Name and mailing address of the ISA/ S.T.P.O. Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES 96/00044

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 517 107 (HAYASHI SEIKO CO.) 9 December 1992 (09.12.92)	1,2
Y	see column 1, line 42 - column 1, line 52 see column 3, line 3 - column 3,line 14 see column 3, line 33 - column 3, line 54 see column 7, line 54 - column 8, line 16 see figures 1,4,5	3,4,6,8

X	DE,A,22 55 137 (REHM) 22 May 1974 (22.05.74)	1,2
Y	see page 3, paragraph 1 - page 4, paragraph 2	3
A	see page 5, paragraph 2 - page 6, paragraph 1 see page 10, paragraph 2 - page 11, paragraph 1 see ifgure 6	5,7,10,11

Y	FR,B,2 088 529 (OROSCHAKOFF) 7 January 1972 (07.01.72) see page 7, line 22 - page 7, line 33 see page 18, line 25 - page 18, line 37 see figures 8-13,78-81	4,6,8

A	DE,A,20 15 952 (DOGANOFF) 21 October 1971 (21.10.71) see page 2, paragraph 2 see page 3, paragraph 3 see page 5, paragraph 4 - page 5, paragraph 5 see figures 3,4	9

Form PCT/ISA/210 (continuation of second sheet) (July 1992)