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

(11) Publication number: **0 474 310 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91202275.3**

(51) Int. Cl.5: **E04B 5/40**

(22) Date of filing: **05.09.91**

(30) Priority: **06.09.90 NL 9001970**

(43) Date of publication of application:
11.03.92 Bulletin 92/11

(84) Designated Contracting States:
BE DE GB LU NL

(71) Applicant: **HOLLANDSCHE BETON GROEP N.V.**
489, Generaal Spoorlaan
NL-2285 TA Rijswijk(NL)

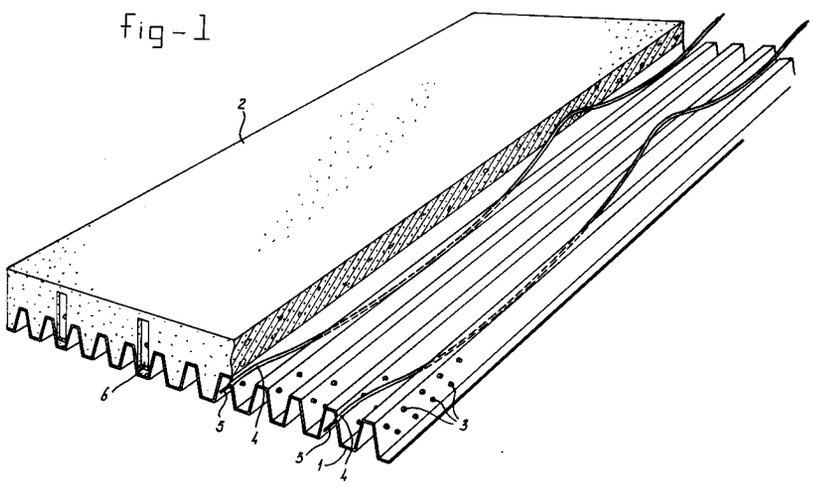
(72) Inventor: **De Sitter, Wolter R.**
Mecklenburglaan 43
NL-1404 BG Bussum(NL)

(74) Representative: **de Bruijn, Leendert C. et al**
Nederlandsch Octrooibureau
Scheveningseweg 82 P.O. Box 29720
NL-2502 LS 's-Gravenhage(NL)

(54) Method for the production of a steel plate concrete floor.

(57) For the production of steel plate concrete floors which can span a considerable length without the concrete being subjected to too great a tensile load under the influence of the weight of the floors themselves and the effective load, and with the deformations standing in the way a practical use, tensioning elements (5) of steel or other elastic material are fitted in the lengthwise direction of the steel plate (1), concrete mortar (2) is poured on the steel plate (1) so that the tensioning members are embedded in the concrete (2), and the tensioning members are placed under tension. The rigid pipes (4) for recessing channels in the concrete are placed over the steel plate (1) in the lengthwise direction thereof, before or after pouring of the concrete mortar the tensioning elements (5) are guided through the channels and are placed under a tensile load after setting of the concrete (2), and the ends of the tensioning elements (5) are anchored in the set concrete (2).

fig-1



EP 0 474 310 A1

The invention relates to a method for the production of a steel plate concrete floor, comprising the pouring of concrete mortar onto a steel plate which, for the purpose of increasing the adhesion between concrete and steel, is provided beforehand with anchoring elements projecting from the plane of the steel plate.

Prefabricated steel plate floor elements produced by this method are known. The steel plate is U-shaped in cross-section, with a flat bottom. Owing to the self-weight of the prefab element and the effective load expected, the bottom side of the floor elements will be subjected to a tensile load. Although the tensile load is absorbed up to a certain value by the steel plate, the maximum permissible span of the floor elements will be limited on account of the fact that concrete can absorb only a very low tensile load. The maximum permissible span of the prefab elements produced with steel plate can be increased by using a thicker steel plate.

The object of the invention is to provide a method such as that indicated in the preamble which leads to steel plate concrete floors which can span a considerable length without the concrete being subjected to too great a tensile load under the influence of the weight of the floors themselves and the effective load, and without the deformations standing in the way a practical use.

For this purpose, according to the invention one or more elements of elastic material such as steel which will bond to the concrete are subjected to a tensile load in the lengthwise direction of the steel plate. In order further to improve the bending resistance in the lengthwise direction, it is highly preferable for the steel plate to have a wavy or crenellated profile at right angles to the lengthwise direction.

Before the concrete mortar is poured, pipes for recessing channels in the concrete are placed over the steel plate in the lengthwise direction thereof, tensioning elements are guided through the channels before or after pouring of the concrete mortar, and said tensioning elements are placed under a tensile load after setting of the concrete, the ends of the tensioning elements being anchored in the set concrete. Said tensioning elements can be, for example, bars, wires or bunches of wires which can be made of steel or glass such as fibres which may or may not be embedded in epoxy resin, plastic such as aromatic polyamide filaments which may or may not be embedded in epoxy resin, or carbon fibres which may or may not be embedded in epoxy resin.

Parallel rectilinear tensioning elements which are pre-tensioned can be fitted at different levels in the thickness of the concrete. The same or better results can, however, be achieved with fewer tensioning elements if the tensioning elements extend in a wavy form through the concrete, the wave valleys being situated approximately halfway between the places where the floor is to be supported permanently in a building.

The steel plate can also be subjected to a tensile load in the lengthwise direction before the concrete mortar is poured by, for example, applying tensile forces to the ends. After setting of the concrete, the forces are removed from the ends.

The method according to the invention could be applied to the production of prefab floor elements, but it is pre-eminently suitable for application to construction itself for the production of extended floors, for example with a total length of 40 metres and spans of, for example, 10 metres. For this, the steel plate is supported at at least two opposite-lying edges by supporting elements of a building and between them by a number of temporary additional bearing elements such as screw jacks, the concrete mortar is poured onto the steel plate serving as the formwork element, and the above-mentioned additional bearing elements are removed after setting and pre-stressing of the concrete.

The anchoring elements are preferably made of studs rolled into the steel plate. These studs prevent the steel plate and the concrete from shifting relative to each other. The inside of the studs can be used at the bottom side of the floors for suspending ceilings, lines of cables and pipes and the like.

The invention will now be explained with reference to the figures.

Figure 1 shows a perspective view of a floor produced according to the invention, in which the concrete is shown partially cut away.

Figure 2 shows a longitudinal section through a building under construction with a floor according to the invention.

The floor shown in Figure 1 has a steel plate 1 with a crenellated profile extending at right angles to the lengthwise direction thereof, on which a layer of concrete 2 is poured. In order to improve the adhesion of the concrete to the steel plate, the latter is provided with projecting anchoring elements in the form of studs 3 rolled into the steel plate.

Before the concrete mortar is poured, form-retaining pipes 4 or the like are fitted over the steel plate in the lengthwise direction of the profile, through which tensioning elements 5 are guided before or after pouring of the concrete mortar. After setting of the concrete the tensioning elements 5 are pre-tensioned, and the ends of the tensioning elements are anchored in the concrete by means of anchoring elements 6. Resin or mortar is injected into the pipes 4 for the purpose of anchoring

and/or protection.

Another possibility of pre-tensioning is the use of virtually rectilinear tensioning elements running in the lengthwise direction of the steel plate floor virtually parallel to each other and at different levels in the thickness, which elements are not fitted in pipes. These tensioning elements are pre-tensioned before the concrete is poured by applying temporary forces to the ends, and the pre-tensioning is removed from the ends of the tensioning elements after the setting of the concrete, as a result of which the concrete is pre-stressed through the adhesion of concrete and tensioning elements. It goes without saying that all kinds of pre-tensioning combinations are possible.

The tensioning elements 5 for pre-tensioning run in a wavy form and, as can be seen from Figure 2, the wave parts are situated approximately halfway between the fixed supports 7 of the floor. So long as the concrete has not yet set, temporary bearing elements 8 such as screw jacks are placed under the floor and are removed after the concrete has set.

The method described above is particularly suitable for use in construction for the production of floors of large dimensions, in particular length dimensions. The steel plate 1 forms a formwork element and replaces the main reinforcement consisting of a woven-wire cloth. The pre-tensioned tensioning elements 5 lead to a very great maximum span length, in particular in conjunction with the profiling of the steel plate. As a result of this profiling and as a result of the steel plate being made thicker, less cable is needed.

Use of the principle of the invention for a prefab floor element is not ruled out.

It is also possible within the scope of the invention to place the steel plate 1 itself under pre-tension. In that case fewer or no tensioning elements 5 at all are needed.

If the tensioning elements 5 to be pre-tensioned do not run in a wavy form, they can be fitted at different levels parallel to each other in the concrete. In general, the steel plate 1 will have no side edges, so that for pouring of the concrete mortar temporary formwork boards will have to be fitted at the sides of the plate 1.

It will be clear that the tensioning elements 5 for pre-tensioning and the steel plate 1 can absorb tensile load at the bottom side of the floor.

What is of vital importance is that through the use of the invention reinforced concrete floors can be made for a very great span without woven-wire cloth, with low thickness, a good bearing capacity, good rigidity and low deformation behaviour.

Claims

1. Method for the production of a steel plate concrete floor, comprising the pouring of concrete mortar onto a steel plate which, for the purpose of increasing the adhesion between concrete and steel, is provided beforehand with anchoring elements projecting from the plane of the steel plate, characterised in that one or more elements of elastic material such as steel which will bond to the concrete are subjected to a tensile load in the lengthwise direction of the steel plate.

2. Method according to Claim 1, characterised in that the steel plate has a wavy or crenellated profile at right angles to the lengthwise direction.

3. Method according to Claim 1 or 2, characterised in that before the concrete mortar is poured, pipes for recessing channels in the concrete are placed over the steel plate in the lengthwise direction thereof, in that before or after pouring of the concrete mortar tensioning elements are guided through the channels, and in that the tensioning elements are placed under a tensile load after setting of the concrete, and the ends of said tensioning elements are anchored in the set concrete.

4. Method according to Claim 1 or 2, characterised in that, before the concrete mortar is poured, tensioning elements are fitted, in that said tensioning elements are placed under a tensile load through the application of tensile forces to the ends of the tensioning elements, in that during the pouring of the concrete mortar and the setting of the concrete the tensioning elements remain under a tensile load, and in that the forces on the ends of the tensioning elements are removed after setting of the concrete, so that the concrete is pre-stressed through the adhesion between concrete and the tensioning elements.

5. Method according to Claim 3 or 4, characterised in that the tensioning elements are bars, wires or bunches of wires which can be made of steel or glass such as fibres which may or may not be embedded in epoxy resin, plastic such as aromatic polyamide filaments which may or may not be embedded in epoxy resin, or carbon fibres which may or may not be embedded in epoxy resin.

6. Method according to Claim 3, 4 or 5, characterised in that the tensioning elements extend in a wavy form through the concrete, the wave valleys being situated approximately halfway

between the places where the floor is to be supported permanently in a building.

7. Method according to any of the preceding claims, characterised in that the steel plate is placed under a tensile load before the concrete mortar is poured.

8. Method according to any of the preceding claims, characterised in that the steel plate is supported at at least two opposite-lying edges by supporting elements of a building and between them by a number of temporary additional bearing elements such as screw jacks, in that the concrete mortar is poured onto the steel plate serving as the formwork element, and in that the above-mentioned additional bearing elements are removed after setting and pre-stressing of the concrete.

9. Method according to any of the preceding claims, characterised in that the anchoring elements are studs rolled into the steel plate.

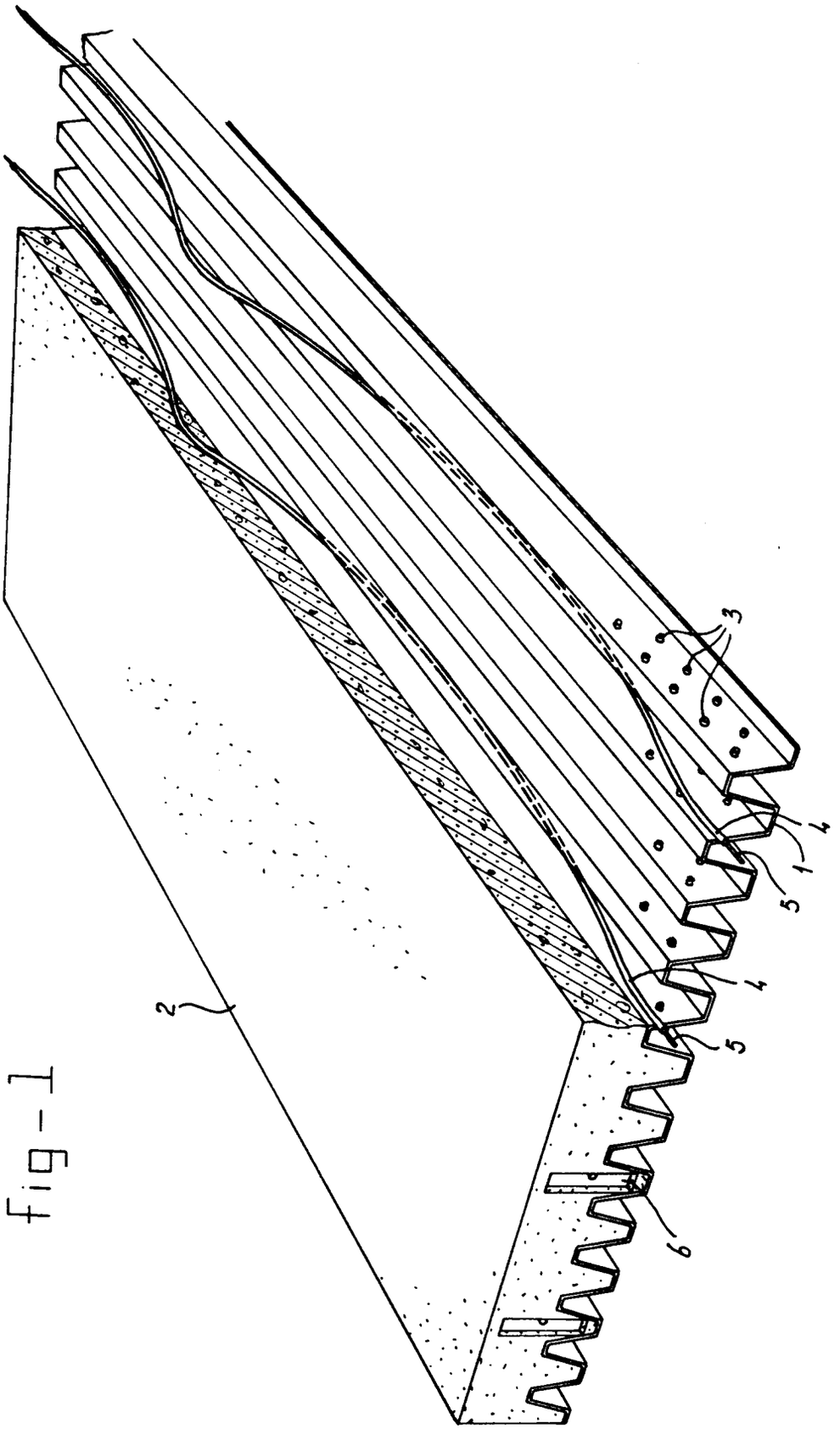


fig-1

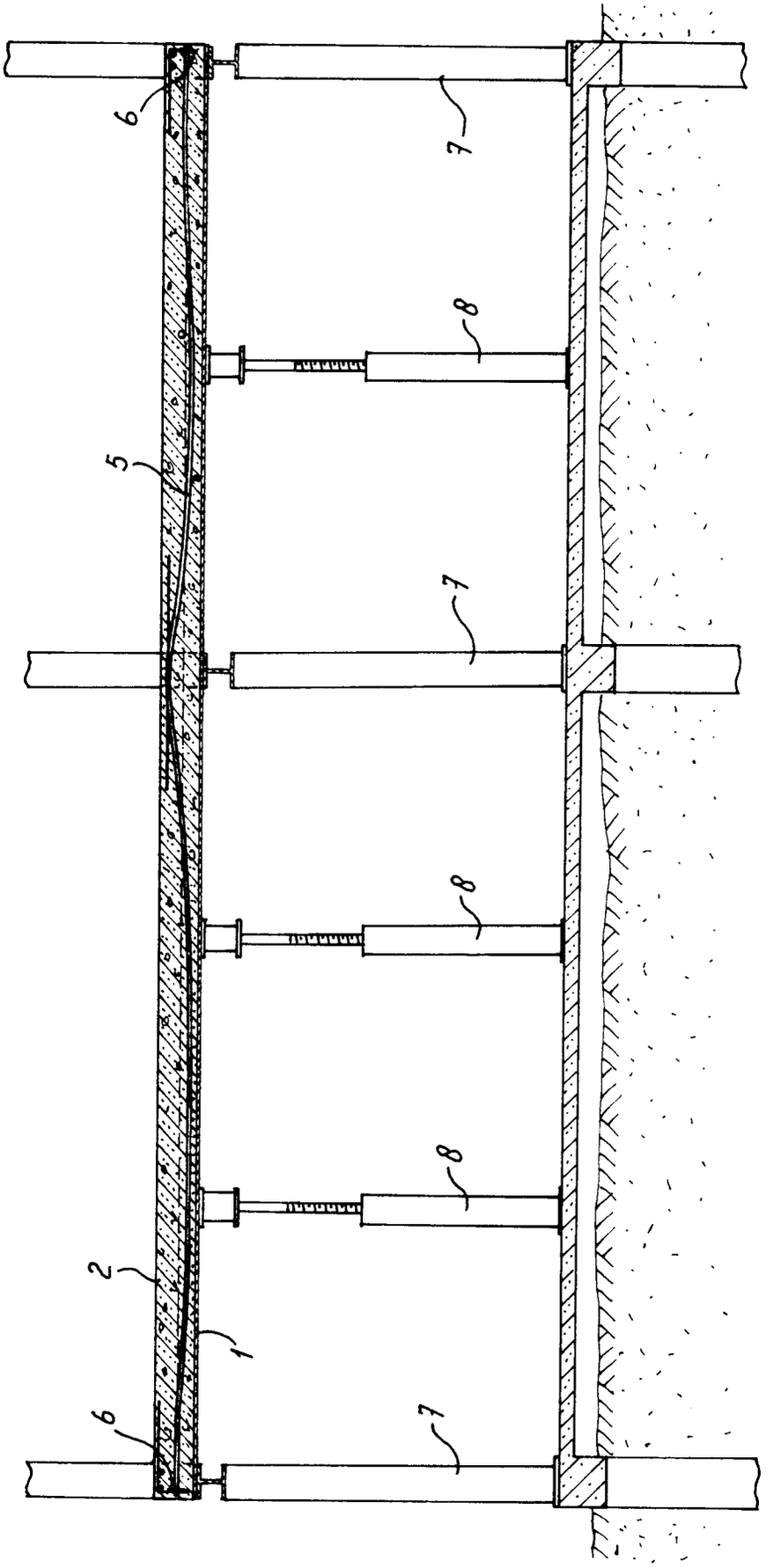


fig-2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 20 2275

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.5)
X	US-A-4 809 474 (EKBERG)	1,2,5,7	E 04 B 5/40
Y	US-A-4 809 474 (* column 2, line 4 - column 2, line 34; claim 1;figures 1,2,3,4 *)	3,9	
X	WO-A-8 801 330 (VAINIONPÄÄ)	1,2,5,7	
Y	WO-A-8 801 330 (* page 1, paragraph 2 - page 1, paragraph 3 *) * page 2, paragraph 3 - page 4, paragraph 1; claims 1,2; figures 1,2 * *	9	
X	US-A-3 712 010 (PORTER)	1,2,5,7	
Y	US-A-3 712 010 (* column 2, line 21 - column 2, line 43 *) * column 3, line 10 - column 3, line 34; claim 1; figures 1-4,9-11 * *	9	
X	US-A-3 862 479 (LADEROUTE)	1,2,5,6,8	
Y	US-A-3 862 479 (* column 3, line 61 - column 4, line 24 *) * column 4, line 68 - column 5, line 8 * * * claim 1; figures 1,4,6,7 * *	9	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
Y	FR-A-2 233 464 (MASCIA ET PERATA) * claims 1,2; figure 1 * *	3	E 04 B E 04 C
Y	NL-A-7 013 151 (K.N. HOOGOVENS EN STAAL-FABRIEKEN) * claims 1,2; figures 1-3 * *	9	
A	US-A-4 709 456 (IYER) * column 4, line 37 - column 4, line 59; figures 1-6 * *	7	

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	29 November 91	HENDRICKX X.

CATEGORY OF CITED DOCUMENTS

- X : particularly relevant if taken alone
- Y : particularly relevant if combined with another document of the same catagory
- 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