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(54) Improved construction method.

(57) A construction method which combines the benefits of precast members and of in situ construction which method comprises supporting a flooring slab on beams, the slab (10, 30, 52, 66) and/or the beams (40, 60, 74) being precast and a topping (26, 68) being subsequently cast over the flooring slab.

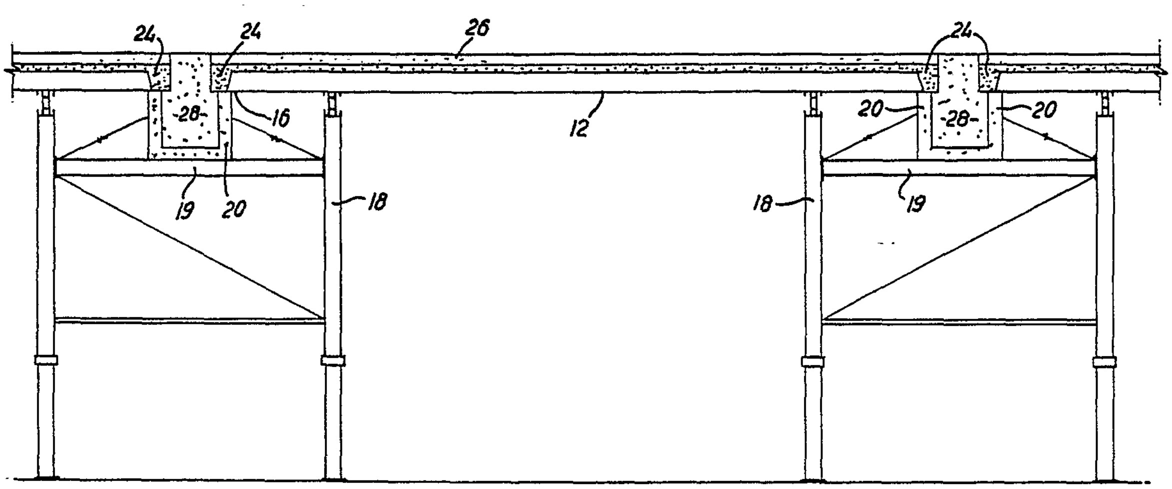

FIG.3

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IMPROVED CONSTRUCTION METHOD

This invention relates to concrete construction and more particularly, but not exclusively, the construction in concrete of beams, spanning slabs and the like.

There are two major methods of building construction using concrete beams and slabs. One method, known as in situ construction is to form the beams and slabs in position in the building. The other method is to pre-cast the elements and then put them in position. Both systems have disadvantages.

For example the in situ method of constructing concrete flooring in a building is to erect formwork over the appropriate area and then pour the concrete onto the formwork. Of course, the formwork and vertical supports therefore must be left in place until the concrete has hardened - usually for several days. This makes the construction process very slow, particularly when a number of floors are to be constructed one above the other.

In order to meet this disadvantage concrete flooring can be constructed using pre-cast concrete slabs as formwork which is left in situ after concrete topping is poured thereon to the desired thickness. pre-cast concrete formwork of a span greater than about 2.0 metres must be supported temporarily until the topping has hardened. The normal kind of support comprises removable props which are located at intervals usually of not more than 2 metres. It has now been found that the pre-cast slab will sag between the props and/or will hog where it is propped with the result that the slab may crack. In order to deal with this problem it has been further proposed in place of temporary props to provide support comprising a plurality of parallel spaced apart metal girders extending above the slab from one side to the other and connected to the slab by metal rods. The provision of all this additional metal makes the system expensive and wasteful particularly since the metal is left in situ after the topping is poured although it has little or no structural role in the finished floor.

Thin section pre-cast formwork slabs can actually tolerate a certain amount of hogging and/or sagging without cracking. However the problem with thin section slabs is that they lack the strength of thicker section slabs and so may be damaged when they are being put in position in the building under construction.

Concrete flooring slabs, either pre-cast or cast in situ are supported at their edges by beams. The beams themselves may be either pre-cast or cast in situ. Pre-cast beams are subject to similar disadvantages as outlined above in connection with pre-cast slabs. The forces imposed on the beams when they are being lifted into position may be different to the forces experienced by the beam when in use, supporting a flooring slab. Additional reinforcement may be needed in the beam to deal with this problem.

The present invention has been made in order to deal with these difficulties.

According to the invention there is provided a building construction method comprising supporting a flooring slab by beams, at least one of said slab or beam being a pre-cast composite reinforced concrete member and casting a topping over said flooring slab.

In this specification the term composite member is a member consisting of a precast reinforced concrete element such as a beam or slab which when incorporated with an in situ reinforced concrete topping forms the actual overall designed composite beam or slab.

In accordance with the invention, therefore, the flooring slab, the beams or both can be pre-cast composite members. When the pre-cast composite slabs are used the beams may be cast in situ, or a combination of pre-cast composite beams and in situ cast beams may be used. similarly when pre-cast composite beams are used the slabs may be cast in situ or a combination of pre-cast composite slabs and in situ slabs may be used. The particular combination of slabs and beams will depend, inter alia, on the kind of building that is being constructed, the use to which the building is to be put and economic considerations. What the invention provides, in practical terms, is a construction system which has to a great extent the speed advantages of a fabrication system using only pre-cast members together with the material economies that are obtainable with in situ construction.

In one preferred embodiment of the invention a pre-cast composite slab includes preformed ribs or beams on at least one side thereof. When ribs are provided on the underside of the slab they are preferably integral with the slab. The slabs can be supported in position by temporary props and beams cast in situ for permanently supporting the slabs whereafter the temporary props are removed. Alternatively the slabs can be supported on pre-cast composite beams.

Another form of slab which can be used in the invention comprises a pre-cast composite member to which beams are removably attached in order to impart strength to the slab while it is being transported and/or put into position in the building under construction. Once in position the strengthening beams are removed and can be re-used on other pre-cast composite slabs.

Specific embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Fig.1 is a section through a pre-cast composite slab;

Fig.2 is a section through a part of the slab of Fig.1 but on an enlarged scale;

Fig.3 is a part section through the building in the course of construction;

Fig.4 is a diagrammatic side elevation of another embodment of a pre-cast composite slab;

Fig.5 is a section on the line IV-IV of Fig. 4;

Fig.6 is a diagrammatic side elevation of a construction including pre-cast composite beams and slabs;

Fig.7 is a detail of a part of the construction of Fig.6 but on an enlarged scale;

Fig.8 is a diagrammatic section through another embodiment of a construction produced in accordance with the invention; and

Figs.9 and 10 show two different kinds of end seating usable with the embodiment of Fig.8.

Referring to Figs. 1 to 3 of the drawings a composite slab of pre-cast reinforced concrete 10 includes a plurality of parallel, spaced apart integral ribs 12 provided on the underside thereof. The ribs 12 are provided with reinforcement 14 adjacent the upper surface in order to resist any tendency to hog as a result of temporary support being applied below the ribs. Reinforcement 15 is provided near the bottom of the ribs to provide tensile strength to the finished construction. Further integral ribs 16 are provided on the underside of the formwork adjacent the two opposite sides which extend transversely to the ribs 12.

There are many ways in which the pre-cast formwork can be employed. In the embodiment illustrated in Fig.3 the pre-cast composite slab is supported in position by temporary adjustable props 18 which engage the underside of the integral ribs 12. The props also carry a horizontal support 19 for formwork 20 for casting in situ beams 22. As can be seen in the drawing the formwork 20 is designed to create shoulders 24 beneath the integral ribs 16 of the pre-cast composite slabs. A topping 26 of concrete is poured over the slabs. The upper surface of the slabs are preferably roughened to ensure a good bond between the slabs and concrete topping 26. At the same time concrete is poured into formwork 20 and between adjacent ends of the pre-cast slabs 10 so as to form beams 28 which will permanently support the flooring.

It will be understood that a greater or lesser depth of concrete topping 26 can be provided if desired. The concrete topping 26 can be reinforced if desired, for example with a metal mesh 23. Reinforcement can also be provided in the beams 28.

The props 18 are removed after the layer 26 and beam 28 have been poured and hardened.

In the embodiment of Figs.4 and 5 a thin section pre-cast composite slab 30 is provided with coarse threaded studs 32 which are anchored to reinforcement 34 and project from the upper side of the slab. U-section channel members 36 are secured to the studs 32 by nuts 38.

The channel members 36 strengthen the slab to enable it to be put in position on temporary props like the embodiment of Figs. 1 to 3 without it breaking. When the slab is in position the U-shaped channel members 36 are removed and can be re-used on other thin section slabs.

Referring now to the embodiment of Figs.6 and 7 pre-cast beams 40 are temporarily supported in position by props 42. Columns 44 are then cast in situ to provide by shoulders 46 permanent support for the beams 40.

It will be noted that reinforcement 48 adjacent the bottom of the beams extends through the end walls of the beams and into the so-called "stitching zone" 50 between the ends of adjacent beams which is in fact the top of the columns 44. The effect of this provision is to produce a continuous beam 40 instead of a series of independent, simply supported, beams, in other words the structure is similar to an in situ construction and has the benefits of the material savings of that construction, but is assembled much more quickly like a pre-cast system yet without the requirement for additional reinforcement that the pre-cast system usually demands.

The flooring as illustrated in Fig.8 is formed by slabs 52 which may be pre-cast, like the embodiment of Figs.1 and 2. A topping is then cast over the slabs to the thickness and quality desired.

The slab of Fig.8 is rather similar to that of Figs.1 and 2 except that the ribs are no longer integral with the slab and the slab itself is of reduced thickness and is rather like a tile. Pre-cast ribs 60 are supported in spaced apart relationship for example as illustrated in Fig.9 by beams 62 which may be produced in situ in connection with Fig.3 or by pre-cast beams of the kind described with reference to Figs.6 and 7.

The opposite longitudinal upper edges of the ribs are provided with rebates 64 which form a seating for thin concrete slabs or planks 66 which span between adjacent ribs. A topping 68 is then cast over the ribs and planks to provide a finished flooring. It can be seen in Fig.8 that the rib reinforcement 70 extends into the topping and in Fig.9 that the rib reinforcement also extends into the "stitching zone" 72 between the ends of adjacent ribs. The finished structure is, therefore, a continuous structure with all the advantages that provides, but without the disadvantages of the slow in situ construction method by which such a structure is conventionally obtained.

Fig.10 illustrates a similar end arrangement to that of Fig.9, instead of the ribs being permanently supported from below by in situ beams the ribs are connected to an in situ spine beam 74 which extends transversely to the ribs through the stitching zone 72 between the ends of adjacent ribs. Metal reinforcement 76 extends from the ends of the ribs into the stitching zone 72 so that a continuous structure is formed.

The invention is not restricted to the above described embodiment and many variations and modifications can be made.

Claims

1. A building construction method comprising supporting a flooring slab by beams, at least one of said slab or said beams being a pre-cast, concrete, composite member and casting a topping over said flooring slab.

2. A method as claimed in Claim 1 wherein the flooring slab is a pre-cast composite slab member and includes integral ribs on one side thereof.

3. A method as claimed in Claim 1 wherein the flooring slab is a pre-cast composite slab member and detachable beams are provided on a surface of said slab, said detachable beams being removed after the slab is in position in the building under construction.

4. A method as claimed in any preceding claim, wherein at least one beam is a pre-cast composite beam member.

5. A method as claimed in any preceding claim wherein concrete is cast in situ linking adjacent pre-cast composite members thereby forming a continuous structure.

6. A method as claimed in Claim 5, wherein reinforcement is provided in the composite members and extends from said composite members into the space between adjacent composite members.

7. A method as claimed in any preceding claim wherein reinforcement is provided in a composite member which projects upwardly from said composite member when in position in the building under construction so as to extend into the topping.

8. A building constructed by the method as claimed in any preceding claim.

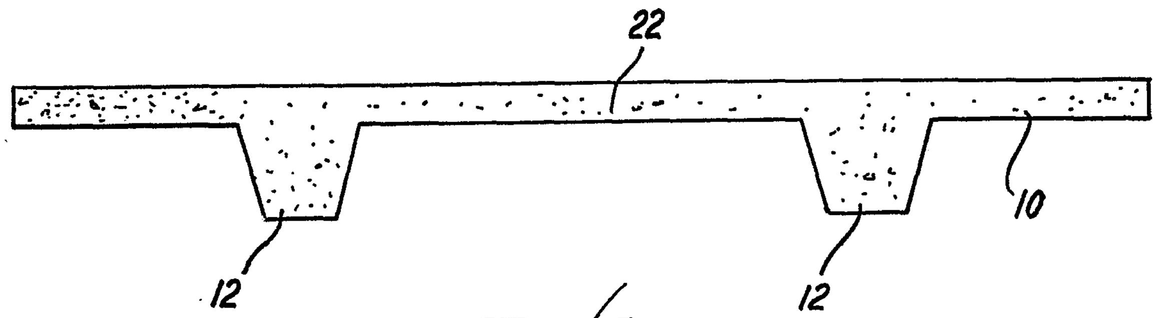

FIG.1

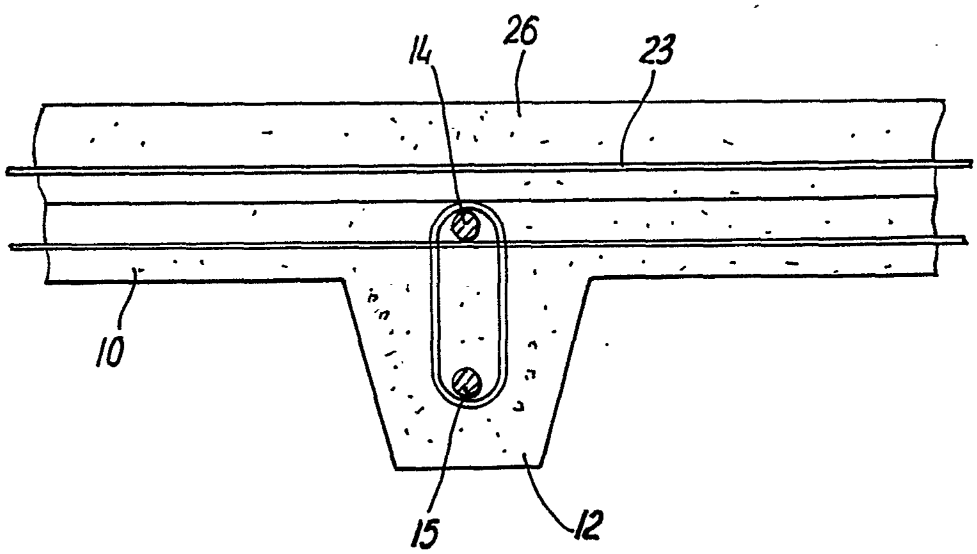

FIG.2

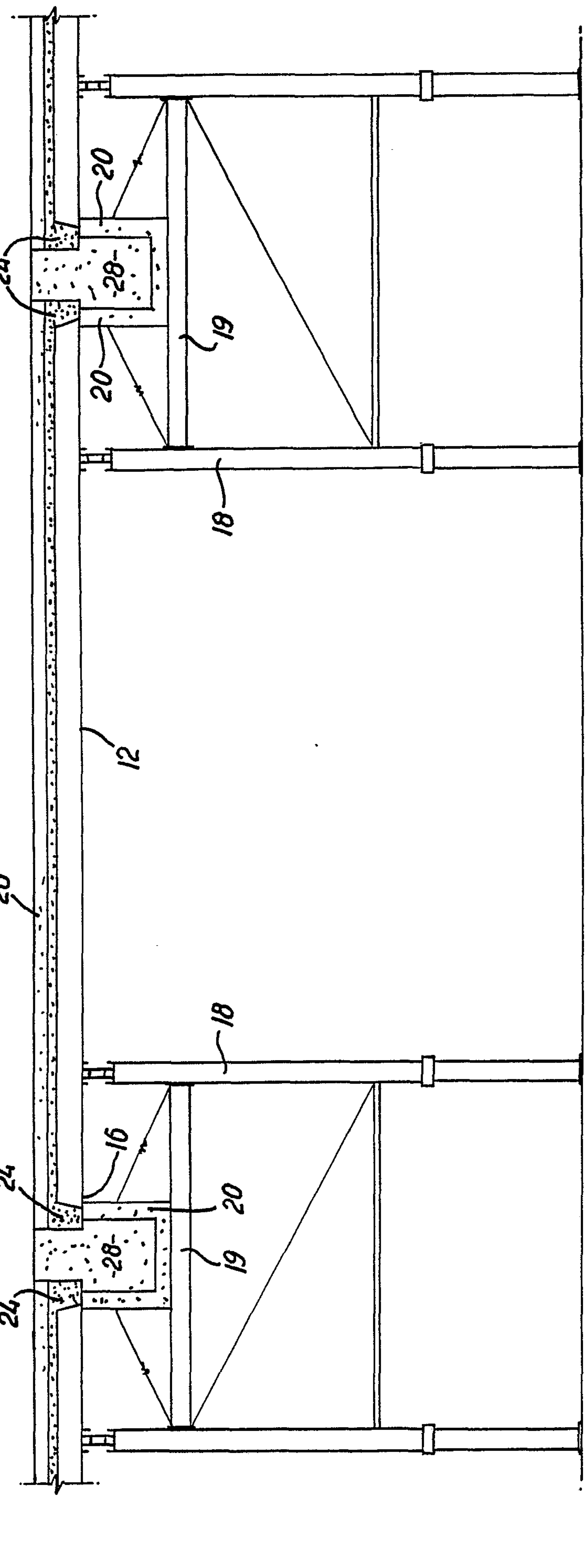

Fig. 3

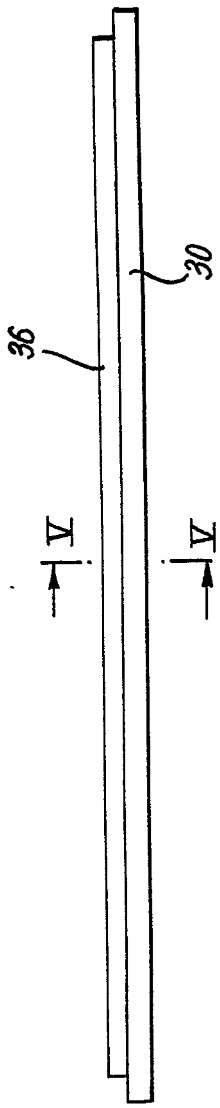

FIG. 4

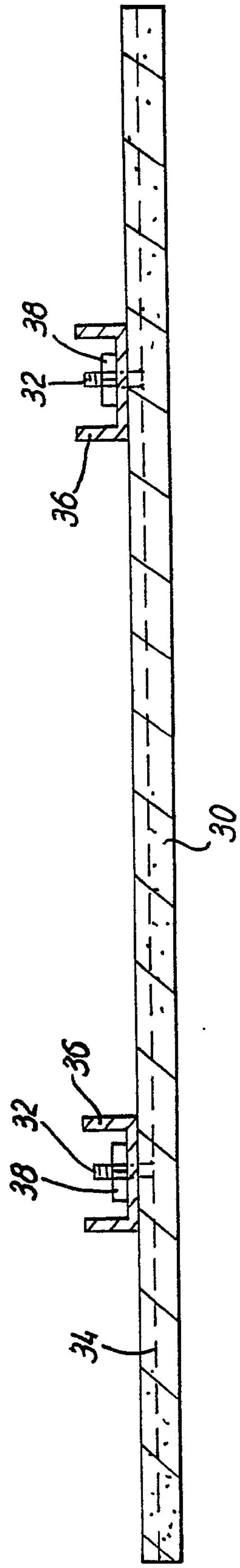

FIG. 5

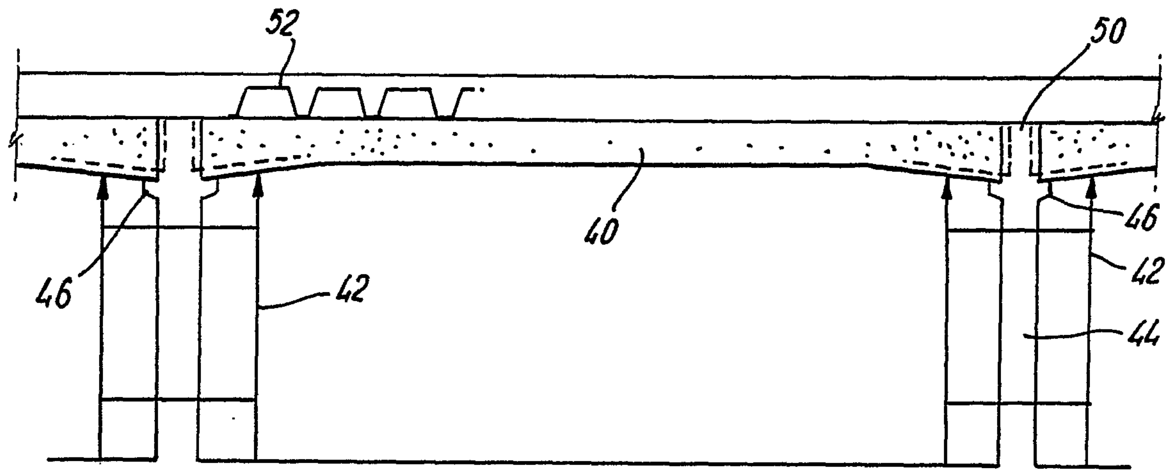

FIG. 6

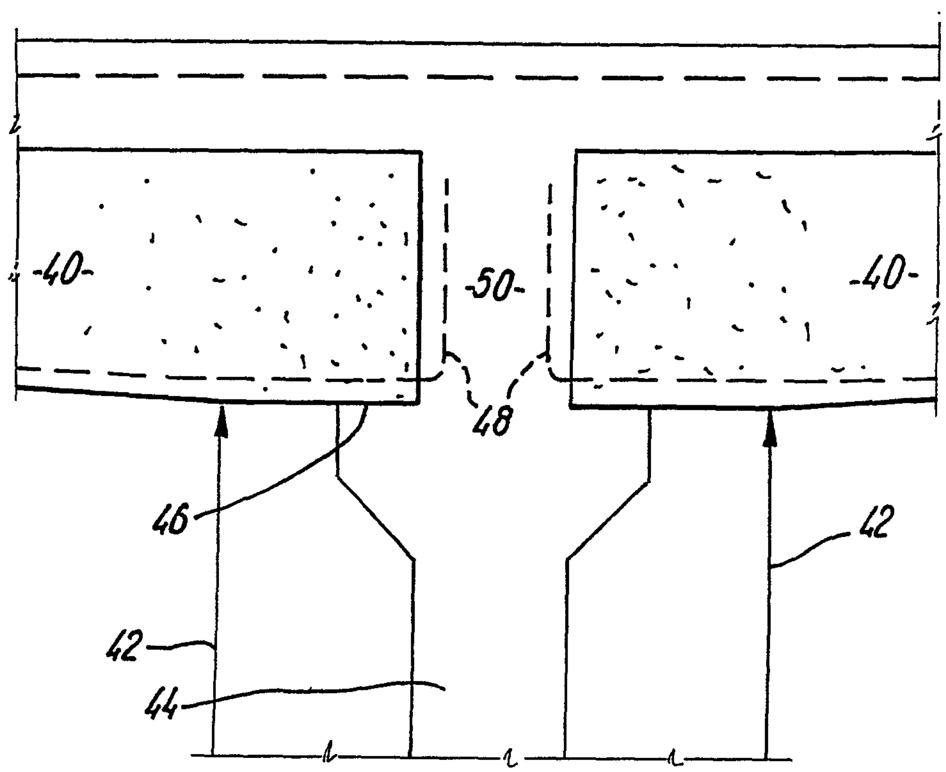

FIG. 7

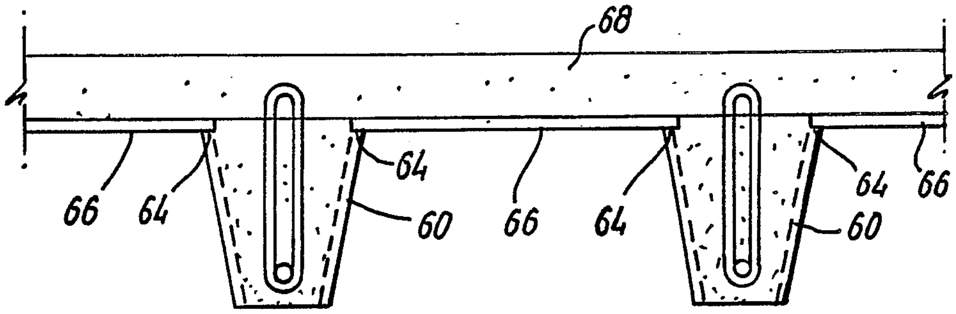

FIG. 8

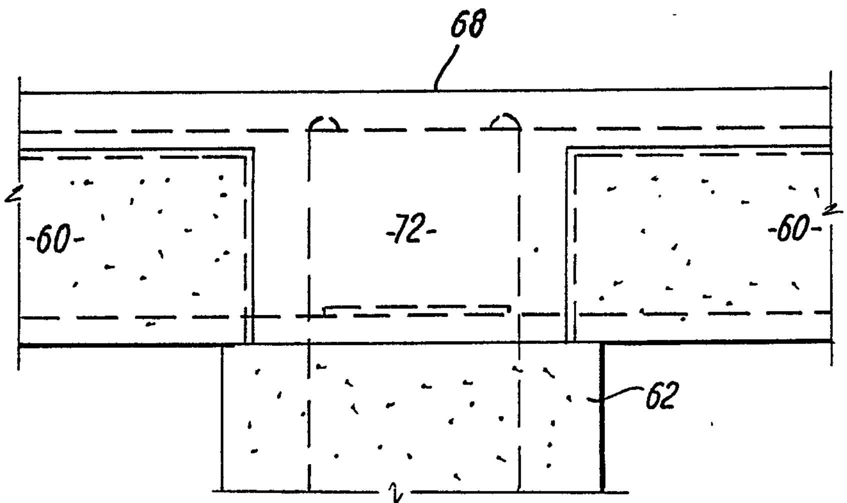

FIG. 9

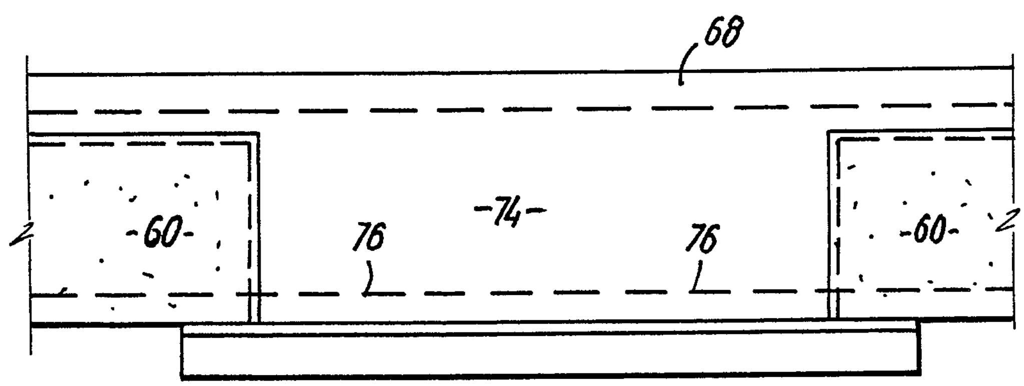

FIG. 10

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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 5033

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.4)
X	GB-A- 553 643 (B. MORTON) * Page 2, column 2, lines 76-102; figures 1,2 *	1,2,4,6-8	E 04 B 5/26
X	FR-A-1 552 242 (A. REIMBERT) * Page 1, column 2, lines 20-27; figure 1 *	1,2	
X Y	DE-C- 507 687 (W. LÜDEKE) * Page 1, lines 50-67; page 2, lines 34-45; figure 1 *	1,4-8 3	
Y	DE-C- 326 513 (A. DREXLER) * Page 1, line 51 - page 2, line 18; figure 1 *	3	
X	DE-A-2 536 307 (F. CONRAD) * Page 4, line 20 - page 5, line 15; figures 1,2 *	1,5-7	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	DE-A-2 234 946 (TRANSGLOBE ENTERPRISE) * Page 4, lines 9-18; page 6, lines 23-24; figure 3a *	3	E 04 B E 04 C
A	GB-A-2 085 502 (TRANSFLOORS PTY. LTD) * Page 2, lines 101-113; figure 9 *	3	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30-08-1989	KRIEKOUKIS S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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