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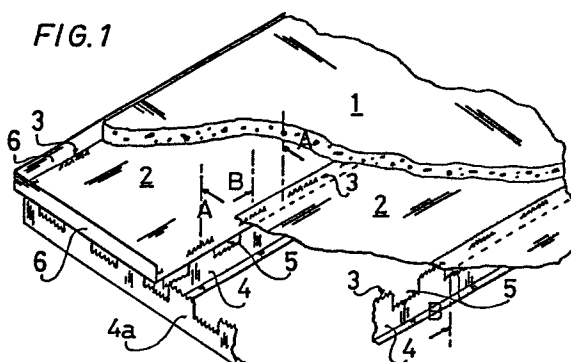
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54 Combined construction plate.

57 Combined construction plates are used as horizontal plates in buildings. A combined construction plate is formed of an element which for instance is cast of concrete, and of steel sheet, as well as of a bottom construction which can for example be beam-like or framework-like. Steel sheet, which in conventional applications is normally profiled, functions both as the reinforcement and the casting mould of the plate. The bottom construction is either a ceiling suspended from the plate and/or a beamwork supporting the plate. In the combined construction plate of the invention the junction between the concrete (1), the sheet metal (2) and the bottom construction (4) is achieved by means of such spike-like members (3) which penetrate the sheet metal (2) and reach through the concrete (1) and the bottom construction (4). The spike-like members are partly or wholly composed of the spikes located in the upper part of the bottom construction, and they can be dented. They can also consist of nails which are nailed through the sheet metal (2), particularly of double-headed nails, in which case the head of the nail remains slightly apart from the surface in order to improve the concrete grip.



COMBINED CONSTRUCTION PLATE

The present invention relates to a combined construction plate, which is combined of a castable or cementable or other such element, made for example of concrete bitumen or gypsum and of thin plate such as steel sheet, or canvas or other such bottom construction, which construction can have the form of a beam, a framework or a plate, or a combination thereof.

Combined construction plates are mainly used as horizontal plates in buildings. In such plates the sheet metal and the concrete function together, so that the sheet metal serves both as the reinforcement and as the casting mould of the plate. Usually profiled sheet metal has been used in such plates, and the following drawbacks can be enlisted:

1. The sheet metal has to be profiled and cut in given dimensions before transporting it to the building site.
2. The profiled sheet metal functions in the plate only in one direction, so that it is often necessary to adjust transversal steel bars on top of the sheet metal.
3. The constructional effects of profiled sheet metal are quite disadvantageous; because only the crests of the profiles fulfil their task effectively, and the rest of the plate is needed only in order to form the mould.
4. The bottom surface of a profiled plate causes a disadvantageous increase in concrete consumption, because only the upper part of the concrete is constructionally effective.
5. It is often necessary to trim the bottom surface of the profiled plate with a separate ceiling, for example by attaching

wooden boarding and a panelling to the plate.

6. It is impossible to adjust transversal electric pipes, water pipes or waste-water pipes within a profiled plate, because the profile cannot be cut owing to constructional and/or technical reasons. Generally it also is impossible to fit pipes within the plates in the longitudinal direction of the profiles, owing to the lack of space in between the profiles.

7. Separate sheet metal plates have to be riveted or screwed together at the edges, because otherwise the juncture would become too weak during the casting, and the casting concrete would filter into the seam between the sheet metal plates.

8. If the plate is used in a continuous fashion in the construction (for example provided with 3 or 4 supports), it is necessary to fortify the top surface of the plate with ordinary steel nets.

9. The plate often becomes so thick that the upper surfaces of the plate edges and the corners have to be reinforced with separate steel bars in order to avoid fractures.

10. At the end of the plate the spaces between the profiles have to be calked, because the sheet metal is practically always mounted on an even base.

11. A separate edge mould is needed for the casting.

12. In order to create a solid grip between the sheet metal and the concrete, the sheet metal has conventionally been provided with brackets or nodules, which make the steel profiling process a slow and expensive one. If brackets are used, the sheet metal holes have to be covered for example by adhesive tape. The use of nodules leads to an increased steel consumption.

13. During the casting, the sheet metal has to be propped underneath, generally at several different points.

14. The use of a combined construction plate has generally been restricted to relatively short spans.
15. The profiled sheet metal has to be relatively thick and of a good, solid quality.
16. With highly profiled sheet metals, self-levelling concrete cannot be used due to working techniques and high costs.

The present invention is based on the observation that below the said combined construction plates there is practically always attached some kind of suspended ceiling and/or beamwork supporting the plate. This ceiling and/or beamwork is hereinafter called the bottom construction. The ceiling may be necessary for esthetic or acoustic reasons, or because of fire safety or the necessity to cover pipeworks. The beamwork supporting the plate is generally always necessary with large spans, because the combined plate of sheet metal and concrete stretches out to relatively short spans (roughly 4-6 m) only. The beamwork can be an ordinary beam, but it can also be a framework or a plate, and it can be made of steel, concrete, wood or other suitable material.

The purpose of the present invention is to eliminate the aforementioned drawbacks and to realize a combined construction plate where the bottom construction, the sheet metal and the concrete form a construction which is at least partially co-functioning. This is achieved by means of the characteristic features of the invention, which are enlisted in the Patent Claim 1.

In a combined construction plate of the invention the upper part of the bottom construction is provided with spikes or for example serrated, and the sheet metal is hammered or pressed against the said spikes. Now the spikes attach the bottom construction to the sheet metal and to the concrete, and the sheet metal at least partially to the concrete, as well as the sheets of metal to each other. The spikes can be attached to the bottom construction also by hammering them through the sheet metal. This kind of procedure is particularly

suitable if the bottom construction is made of wood. In typical embodiments of the invention the sheet metal is unprofiled and the beam-like members of the bottom construction, as well as the spikes thereof, are located relatively near to each other. Now all of the above enlisted drawbacks 1-16 of the combined plate can be eliminated and the following advantages achieved:

- The sheet metal can be smooth, unprofiled and unprocessed.
- The smooth sheet metal functions in two directions, because the juncture endures both traction and shearing forces.
- The smooth sheet metal functions advantageously in the bottom surface construction, wherefore the sheet metal can be thin and of a normal quality.
- Concrete consumption is small.
- It is not necessary to build a fixing frame for a possible ceiling.
- The bottom construction can easily be made such (for example by employing a framework-like construction) that all kinds of piping can be fitted therein in all directions.
- It is not necessary to separately attach each piece of sheet metal at the junctures, if the pieces are laminated at the spikes.
- If the construction functions as a continuous structure provided with intermediate supports, separate reinforcement steels in the concrete are unnecessary, because the sheet metal endures traction forces.
- The plate can be made so thin that separate reinforcement at the edges and in the corners becomes unnecessary.
- The calking generally required at the edges preparatory to casting becomes unnecessary.
- A separate edge mould becomes unnecessary, because the sheet metal can be folded to serve as the edge

mould.

- The spikes of the bottom construction create an effective grip between the sheet metal and the concrete.
- It is generally unnecessary to build any interim supports for the casting.
- Depending on the type of the bottom construction, the plate can also be used with medium and long spans.
- The sheet metal can be thin and of an ordinary quality.
- Self-levelling concrete can be used, because only a thin layer of concrete is needed.

In the following the invention is explained in detail with reference to the appended drawings:

Figure 1 is an axonometric illustration of a construction plate according to the invention.

Figure 2 shows the cross-section A-A of the plate of Figure 1, seen in perpendicular direction to the beams.

Figure 3 shows the cross-section B-B of the plate of Figure 1, seen in the lengthwise direction of the beams.

Figure 4 shows a cross-section view of such a combined construction plate where the bottom construction is a combination of a steel grate and a concrete slab.

Figure 5 shows the cross-section C-C of the plate of Figure 4.

Figure 6 shows a cross-section of such a plate (end of the plate), where the bottom construction is formed of wooden beams and where the spike-like members are formed of nails.

In Figure 1 the bottom construction of the combined construction plate is a steel beamwork 4, where the beam itself is made of Z-profile by splitting it so that spikes 3 are formed in the beam. It is normally advisable to carry out the splitting so that the plate will be provided with gaps 5. Thus it is possible to save

material, and piping adjustments can be made inside the plate in the transversal direction of the beams 4. The sheet metal 2 is laminated at the beam 4 and folded at the edge to form the casting mould 6. It is generally advisable to cut teeth in the spikes 3 of the beam 4 in order to improve the concrete grip. The row of spikes should also be designed so that it has a wave-like form, in order to avoid a weak, straight line in the sheet metal. In addition to this, the row of spikes should be designed so that it has a groove-shaped cross-section in order to make the spikes penetrate the sheet metal and prevent them from bending aside. The concrete 1 is cast on top of the sheet metal. If the spikes belong to the bottom construction, the sheet metal can be attached thereto for example by mounting it on top of the bottom construction. The sheet metal is hammered for example with a rubber-headed or a wooden hammer, so that the spikes penetrate the sheet.

At the end of the plate, there can be arranged in transversal direction the beam 4a, which is particularly useful if the sheet metal is unprofiled:

- The beam 4a prevents the intervals between the rest of the beams from shortening due to the pellicular power of the sheet metal.
- The beam 4a provides the sheet metal with an effective grip at the end of the plate.

The sheet metal can naturally be adjusted on top of the beams 4 in transversal direction, too, but generally it is not recommendable from the point of view of constructional reasons and working techniques. The sheet metal can also be profiled, in which case the interval between the beams 4 can be long.

Figure 4 shows a cross-section view of such a combined plate where the bottom construction is a concrete slab

with a steel grate attached thereto. In this case the spikes 3 are cut in the pair of bars functioning as the upper beam of the steel grate. This is profitable because now there will be only a small amount of sheet metal penetrations in a same straight line, but the junction between the sheet metal and the concrete becomes firm - for example it endures transversal traction, which is important if the plate should function constructionally in two directions. The construction of Figures 4 and 5 can also be used without the concrete slab which is located underneath.

Figure 6 shows a lengthwise cross-section view of such a plate where the bottom construction is formed of wooden beams. Such a construction is particularly advantageous in small houses, specially in floors, ceilings and all kinds of thermally insulated structures, among others as outer walls of light industrial halls.

When the bottom construction is made of wood, it is possible to attach the sheet metal-concrete plate to the bottom construction by means of a truss plate with dented edges. Sheet metal and concrete can be attached to the bottom construction also by nailing the sheet metal to the wood so that the head of the nail is left slightly apart from the sheet metal. The so-called two-headed nail is particularly suitable for this purpose.

If a truss plate is employed in fixing the plate, it is possible to leave a gap between the sheet metal and the wood. A transversal board or equivalent can then be placed at the gap to support the metal sheet, in which case the intervals between the wooden beams can be comparatively long.

The bottom construction can also be of some other type;

it can be for example an element of profiled sheet metal as in the Finnish Publication Print 51628 or a wooden framework as in the Finnish Publication Print 60752.

One advantageous and important embodiment of the invention relates to the ceiling of a building with a low-pitched roof. The concrete can be made so that it is resistant to weather; a separate water proofing is generally unnecessary, or the water proofing can be simpler than normally - for example an insulating layer of paint or spray - because sheet metal is a compact construction material. This leads to remarkable savings in building costs, because in conventional building it has been necessary to provide the construction with separate water proofing.

If the bottom construction material is wood and the spikes are nails, it is profitable to carry out the nailing so that the shift, which is the outcome of the shearing strain in the juncture, tightens the sheet metal against the wood. Such an effect is achieved by hitting the nails in a slanted position in the direction of the diminishing shearing force of the wood, i.e. so that the head of the nail points to the middle of the span.

In order to make the sheet metal and the concrete to stick properly to each other, it is essential that a firm grip is achieved at the edges of the plate, because normally the sheet metal tends to loosen from the concrete starting from the edges. If the edges of the metal sheet are firmly attached, only few gripping spikes are needed in the middle part of the sheet. Moreover, if there is a solid grip at the edges, it is not dangerous if the middle part of the sheet metal loosens from the concrete. The folding of the sheet metal to form a mould at the edges essentially improves the edge grip, particularly if there are gripping spikes or equi-

valent at the edge regions, too, and/or when the end of the plate is turned preparatory to casting.

The sheet metal used in the plate of the invention is normally smooth, but when long mutual intervals are used in the bottom construction, it is necessary to stiffen the sheet metal for example by profiling. A particularly good result is achieved if the sheet metal is transversally profiled only in the middle part. Alternatively it is possible to use the transversal supports which are employed during the casting or which remain as parts of the bottom construction; a plurality of wide-spaced boards placed under the sheet metal is economical in several different applications. If the bottom construction has long intervals, it is easy to corrugate the sheet metal by providing the top surface of the bottom construction with a wave-like shape. If it is necessary that the plate functions constructionally in two directions, or if the construction should be reliably compact, it is profitable to cement or joint the plates to each other at the laminating juncture. This can be done by means of cementing or jointing materials (which allow for strain), or the ends of the metal sheets can be jointed as a conventional sheet metal juncture, particularly so that the edge of the juncture is folded against the concrete in order to strengthen the grip.

One remarkable embodiment of the invention is a plate with self-levelling cast. The volume price of such a cast is from 2 to 20 times higher than that of an ordinary cast. Therefore it is important that the layer of concrete is as thin as possible. In the structure of the present invention, the thickness of the layer of concrete can be reduced to one fourth of the cast thickness of an ordinary construction plate.

PATENT CLAIMS

1. A combined construction plate, which is composed of a castable, cementable or other such element, made for example of concrete and of thin sheet metal such as : steel sheet, or canvas or equivalent, and of a bottom construction which can have the form of a beam, a framework or a plate or a combination thereof, c h a r a c - t e r i z e d in that the junction between the concrete (1), the sheet metal (2) and the bottom construction (4) is achieved by means of such spike-like members (3) which penetrate the sheet metal (2) and reach through the concrete (1) and the bottom construction (4).

2. The plate of Claim 1, c h a r a c t e r i z e d in that the spike-like members (3) consist partly or wholly of the spikes located in the upper part of the bottom construction (4).

3. The plate of Claim 1 or 2, c h a r a c t e r i - z e d in that the spikes or equivalent members are den-
ted.

4. The plate of Claim 1, 2 or 3, c h a r a c t e r i - z e d in that the spike-like members (3) consist partly or wholly of nails which are nailed through the sheet metal (2), particularly of so-called double-headed nails, where the head of the nail remains slightly apart from the surface in order to improve the concrete grip (Fi-
gure 6).

5. The plate of any of the above claims, applied in a roof construction, c h a r a c t e r i z e d in that the concrete (1) and the steel plate (2) are arranged to serve partly or wholly as weather-proofing elements.

6. The plate of any of the above claims, c h a r a c -
t e r i z e d in that the sheet metal is unprofiled.

7. The plate of Claim 6, c h a r a c t e r i z e d in
that the sheet metal (2) is folded at the plate edges
to form a casting mould, particularly so that the grip
between the sheet metal edge and the concrete is effi-
cient.

8. The plate of Claim 6 or 7, c h a r a c t e r i -
z e d in that the metal sheets (2) are attached to each
other at the spike-like members (3) which belong to the
bottom construction (4).

9. The plate of any of the above claims, c h a r a c -
t e r i z e d in that the spike-like members (3) of
the plate are nails which are nailed into wood or other
such material, and that the nails are nailed in a slan-
ted position so that the shearing strain tightens the
juncture.

10. The plate of any of the above claims, c h a r a c -
t e r i z e d in that the holes created in the sheet
metal by the spike-like members (3) are not located in
a straight line.

11. The plate of any of the above claims, c h a r a c -
t e r i z e d in that the bottom construction (4) is
formed of a split Z-, I- or other such profile.

12. The plate of any of the above claims, c h a r a c -
t e r i z e d in that the sheet metal (2) is corruga-
ted, which form is partly or wholly achieved by means
of the wave-like structure of the upper part of the bot-
tom construction.

13. The plate of any of the above claims, c h a r a c t e -
r i z e d in that, a self-levelling cast is used (concrete,
leveller, bitumen, gypsum etc.).

14. The plate of any of the above claims, c h a r a c t e -
r i z e d in that, the bottom construction is formed of
wooden beams which are provided with such pressed-in truss
plates that have spikes at their edges.

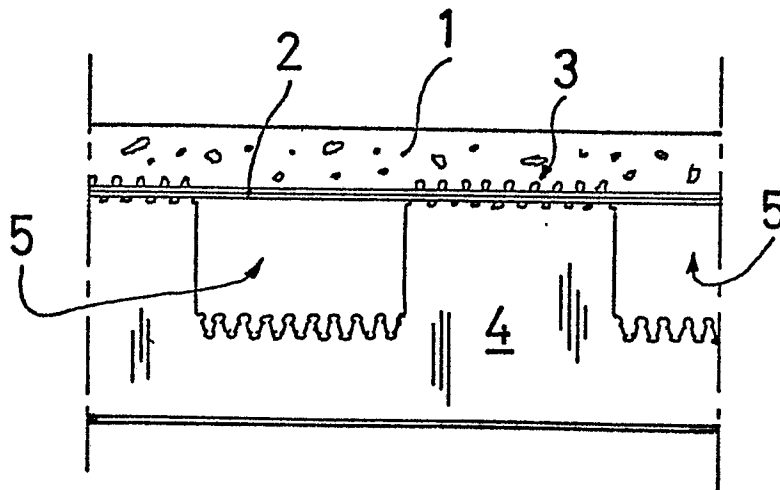
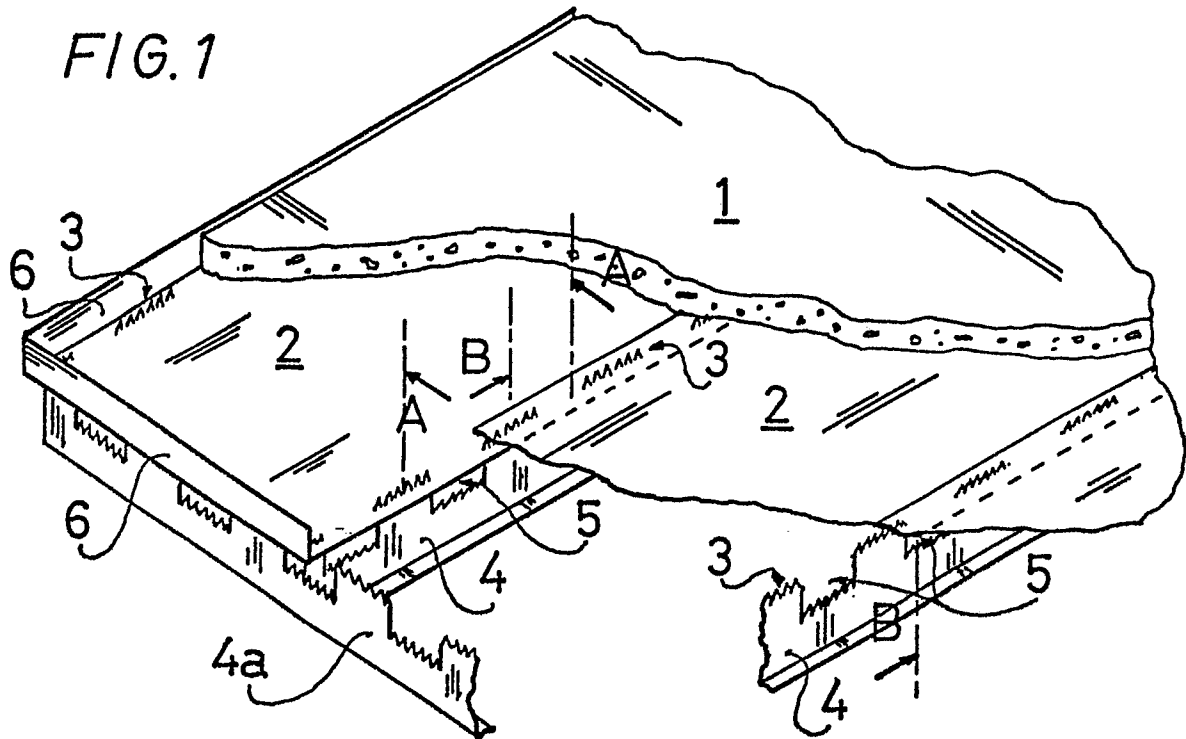


FIG. 2

FIG.3

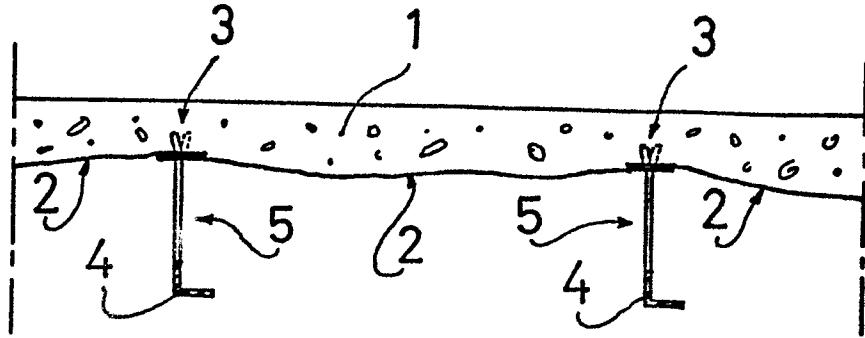


FIG.4

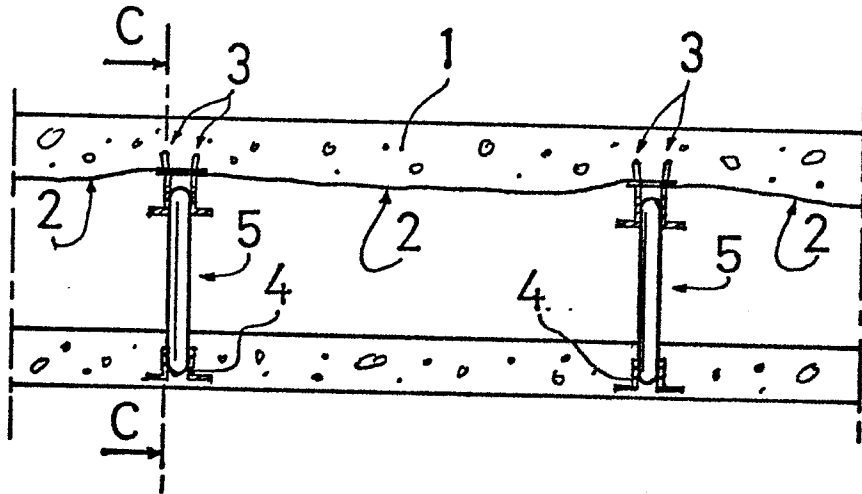


FIG.5

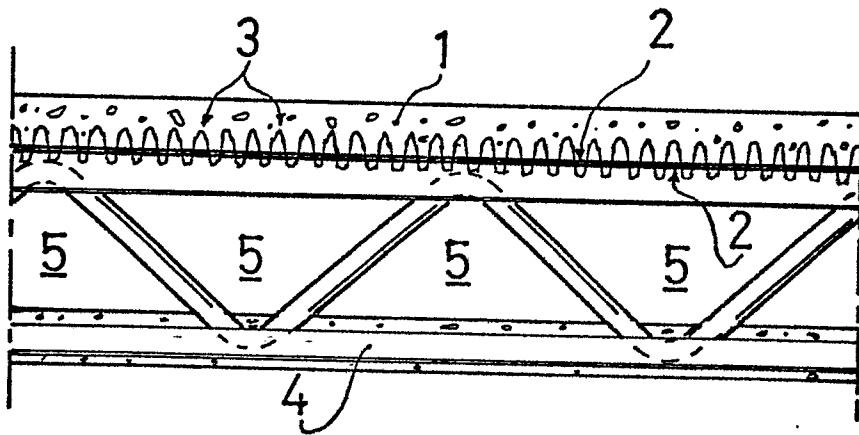
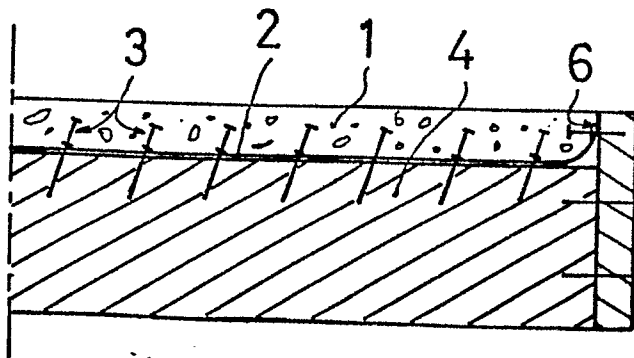


FIG.6





European Patent
Office

EUROPEAN SEARCH REPORT

0104629

Application number

EP 83 10 9505

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. *)
X	DE-C- 843 152 (SCHLESINGER et al.) * Page 2, lines 27-70; figure 2 *	1,2	E 04 C 2/26
A	DE-A-2 600 662 (WESTEEL-ROSCO LTD.) * Page 8, last paragraph - page 13; figures 1-6 *	1,2	
A	BE-A- 567 883 (FIRE-PROOF STEEL CO. LTD. et al.) * Pages 2, 3, 10; figures 1-7 *	1,3,5,6	
A	DE-B-2 700 416 (JUNGBLUTH) * Complete document *	1,5,12	
A	CH-A- 19 273 (KATZ) * Complete document *	4,9	TECHNICAL FIELDS SEARCHED (Int. Cl. *)
A	DE-A-2 413 645 (UNGER) * Page 5, paragraphs 4, 5; figures 22, 23 *	11	E 04 C 2/00
A	DE-A-2 924 960 (KUROS)		
A	DE-A-2 700 588 (JUNGBLUTH)		
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 19-12-1983	Examiner PAETZEL H-J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category 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			