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(54) **Acoustic insulating panel**

(57) An acoustic insulating panel (1) made of composite material and having a shell (8) in turn having a number of longitudinal reinforcing ribs (10, 13) and at least one layer (16, 17) of sound-absorbing material housed between two adjacent ribs (10, 13); the shell (8) being formed by bending thin sheet material; the layer (16, 17) of sound-absorbing material being sprayed or poured on, or applied by mechanically fastening and/or chemically bonding preformed elements; and the sound-absorbing material being replaced by or integrated with a further layer (18) of vibration-damping material.

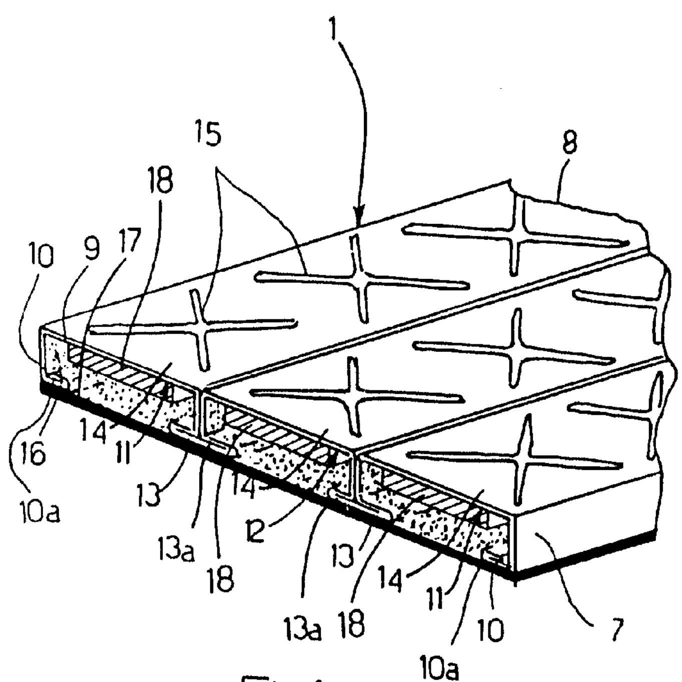

Fig.1

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Description

The present invention relates to an acoustic insulating panel for insulating preferably open spaces from pollutant sound waves.

In the construction of acoustic insulation barriers for protecting environments against the noise produced by automobiles, trains, building sites or industrial plants, thin, elongated, substantially parallelepiped panels are known to be placed one on top of the other on edge to form a substantially vertical wall physically separating the noise source from the environment for protection. Such panels are made of composite material, and are held in place one on top of the other between two uprights comprising longitudinal grooves engaged by lateral end portions of the panels. At assembly, the uprights therefore act as slideways for the panels, which, as they are inserted downwards, must be kept coplanar with the plane defined by the uprights.

Each panel comprises a substantially parallelepiped shell of a given thickness, normally made of zinc-plated painted sheet metal, and which acts a container for filler material, such as mineral wool or similar. The shell is normally formed by assembling two half shells, mainly provides for acoustic insulation as opposed to the mainly sound-absorbing function of the filler material, and is normally closed at the ends by endpieces which fit loosely inside the grooves in the uprights. Assembly of the panels is a painstaking job, which is performed entirely at the factory.

The mass of the panels per unit of length is considerable, and combines with the long length of the panels to improve acoustic insulation performance.

On the other hand, however, the considerable thickness, weight and length of the panels make them difficult to transport and handle safely with no risk of damage during installation. In view of the impact on urban environments of acoustic insulation barriers, which are erected in full view in the open, the panels must be handled carefully in outdoor locations not normally equipped for the purpose, using expensive heavy-duty self-propelled equipment.

Moreover, the necessity to complete the panels at the factory is a further limiting factor if, for any reason during installation, the center distance between two adjacent uprights is other than that required to assemble the panels. In which case, completion of the barrier involves producing a small number of nonstandard-size panels, thus resulting in considerable downtime and extra cost by interrupting normal output.

It is an object of the present invention to provide an acoustic insulating panel designed to overcome the aforementioned drawbacks, and which is easy to transport and install.

According to the present invention, there is provided an acoustic insulating panel made of composite material and by which to form a barrier for reflecting, absorbing and damping incident sound waves; the panel comprising a shell defined longitudinally by substantially C-shaped edges; and the panel being characterized by comprising a number of reinforcing ribs, and at least one layer of sound-absorbing material housed between at least two adjacent ribs; each rib having a cross section of a given shape; and the shell being formed by bending thin sheet material.

The sound-absorbing material may be replaced by or integrated with a layer of vibration-damping material.

A non-limiting embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a view in perspective of a panel in accordance with the teachings of the present invention;

Figure 2 shows a smaller-scale view in perspective of a barrier formed using a number of the Figure 1 panels;

Figure 3 shows a smaller-scale view in perspective, with parts removed for clarity, of a further embodiment of the Figure 2 barrier.

Number 1 in Figure 1 indicates as a whole an acoustic insulating panel from which to form an acoustic insulating barrier 2 surrounding, and for preventing the propagation of pollutant sound waves from, open spaces containing main roads, motorways, railways, building sites, airports or industrial plants.

Barrier 2 comprises a number of flat walls 2b arranged one after the other so that, from above, barrier 2 resembles a broken line. Each wall 2b is defined longitudinally by two uprights 3 in turn defined by two straight, parallel, substantially vertical rods; and each upright 3 comprises a ground anchor plate 4, and an H-shaped cross section defining two opposite C-shaped longitudinal grooves 5.

As shown in Figure 2, each wall 2b comprises, between two adjacent uprights 3, a number of substantially identical panels 1, which are made of composite material, are substantially parallelepiped in shape, and are arranged on edge one on top of the other with respective substantially parallelepiped end portions 7 engaging grooves 5 of uprights 3. Grooves 5 therefore provide for guiding panels 1 at assembly, and for subsequently holding them in place.

As shown in Figure 1, each panel 1 comprises an elongated metal shell 8 with a substantially rectangular cross section of a thickness approximately equal to but no greater than the thickness of panel 1; and, as shown in Figure 1, each panel 1 is covered with a cushion 9 made of composite material, and which is normally applied to the noise source side of panel 1. Shell 8 mainly provides for acoustic insulation, and cushion 9 mainly for sound absorption.

Shell 8 may be formed by rolling thin, zinc-plated sheet steel or aluminium, and is coated with waterproofing material, such as paint or a plastic film.

Shell 8 comprises a number of reinforcing ribs formed, for example, when rolling the sheet from which shell 8 is formed, and which comprise end ribs 10 - hereinafter referred to simply as edges 10 - defining the top and bottom of shell 8 and formed by bending the sheet into a C, and T-shaped ribs 13 (only two shown in Figure 1) located between edges 10. Shell 8 therefore comprises, between two ribs 13 or between a rib 13 and the adjacent edge lo, a longitudinal portion 14 of the same length as shell 8 itself. Each edge 10 and the adjacent rib 13 define a first container 11 open at the bottom in Figure 1 and for freely receiving cushion 9; and each two adjacent ribs 13 define a second container 12 also open at the bottom in Figure 1 and for freely receiving cushion 9.

Edges 10 and ribs 13 comprise respective wings 10a, 13a parallel to longitudinal portions 14, and which act as supporting members by which to fit panels 1 in any axial position to the outside of uprights 3 by means of metal plates 3a fittable to the body of uprights 3 (Figure 3). This method of connecting shells 8 to uprights 3 provides for greatly simplifying the erection of barrier 2 by permitting a greater tolerance between the axes of uprights 3 than when shells 8 are inserted inside grooves 5 of adjacent uprights 3 (Figure 2). Wings 10a and 13a therefore act as elongated supporting members of substantially the same length as shell 8, and which are particularly suitable for assembling the panels regardless of the distance between the axes of uprights 3.

Each portion 14 comprises a number of evenly spaced impressions 15, which in Figure 1 are X-shaped, but which may also be Y-shaped or in the form of a cross. Besides reinforcing the structure (increasing the bending resistance) of shell 8, impressions 15 also provide for improving the acoustic insulating and damping capacity of panel 1 by greatly increasing the natural vibration frequency.

With reference to Figure 1, cushion 9 comprises a layer 16 contacting shell 8 and made of sound-absorbing material, such as glass fiber, rock fiber, loose expanded clay, expanded clay with chemical binders or cement, open-cell expanded plastic (polyurethane, polyester) , waste rubber, sound-absorbing asphalt, porous cement, etc. All these materials may be used alone or in appropriate mixtures.

Layer 16 may be sprayed, poured, bonded or fastened on.

Cushion 9 may also comprise a second layer 17 of caoutchouc or other sound-absorbing rubber material, which is sprayed over layer 16 to protect it against damp, atmospheric agents and mechanical shock.

Figure 1 shows a possible third layer 18 of damping material for reducing free or forced vibration induced in panel 1, and more specifically in shells 8, and so reducing the amount of noise propagated by way of the structure. The damping material may comprise, for example, modified filled bitumen, modified filled butyl, or high-density laminated plastic.

Use of panel 1 in the formation of barrier 2 is clearly understandable from the foregoing description with no further explanation required.

Shells 8 are therefore so formed as to be transportable in stacks, with ribs 13 facing one another to reduce the height of the stacks, and are light enough to be handled using cheaper, more agile lifting equipment.

Clearly, changes may be made to panel 1 as described and illustrated herein without, however, departing from the scope of the present invention.

The design of panels 1 provides for major advantages as regards the formation of barrier 2, a low-cost method of which comprises the steps of erecting uprights 3 between the noise source and the region for insulation, so that the uprights are equally spaced and parallel to one another, with respective grooves 5 substantially facing each other in pairs; inserting shells 8 one after the other from the top, with respective portions 7 inside grooves 5 of adjacent uprights 3; sliding each shell 8 downwards until a respective bottom edge 10 contacts anchor plates 4 or the top edge 10 of the shell 8 underneath; spraying the sound-absorbing material inside shell 8 to fill containers 11 and 12 and so form layer 16; connecting portions 7 of each shell 8 permanently and in soundproof manner to respective uprights 3; and spraying on layer 17 to cover the whole of layer 16.

The step of spraying the sound-absorbing material inside shell 8 comprises the step of connecting portions 7 of each shell 8 permanently and in soundproof manner to grooves 5 of respective uprights 3, and must be done carefully to ensure layer 16 penetrates and completely fills the gap defined between an edge of groove 5 and the corresponding portion 7.

If shells 8 are longer than the space available between grooves 5 of adjacent uprights 3, the step of inserting shells 8 is necessarily preceded by the on-the-spot step of adapting the length of shells 8 as required, e.g. by manually shearing off the surplus material, thus avoiding the added cost and inconvenience of returning shells 8 to the factory.

Once shells 8 have been inserted downwards between uprights 3, the sound-absorbing material may be sprayed inside to completely fill containers 11 and 12.

Figure 3 shows the simplified embodiment, described previously, of barrier 2, in which uprights 3 are fitted with plates 3a, and which is particularly suitable in the event, for any reason, the real distance between the axes of uprights 3 is less than that designed to assemble shells 8 inside grooves 5. In which case, the insertion step is replaced by the step of fitting panels 1 to the outside of uprights 3 by simply inserting wings 10a, 13a inside the gaps defined between the face of uprights 3 and respective plates 3a.

The method described provides for greatly simplifying the in-plant part of the panel 1 production cycle, and so reducing the cost of transporting and handling the component parts of the panel.

Claims

1. An acoustic insulating panel (1) made of composite material and by which to form a barrier for absorbing pollutant sound waves; said panel (1) comprising a shell (8) defined longitudinally by substantially C-shaped edges (10); and being characterized by comprising a number of reinforcing ribs (10, 13), and at least a first layer (16) of sound-absorbing material housed between at least two adjacent said ribs (10, 13); each said rib (10, 13) having a cross section of a given shape; and said shell (8) being formed by bending thin sheet material.

2. A panel as claimed in Claim 1, characterized in that said at least a first layer (16) of sound-absorbing material is covered by at least a second layer (17) of insulating and sound-absorbing material, such as caoutchouc or similar.

3. A panel as claimed in any one of the foregoing Claims, characterized by comprising at least a third layer (18) made of damping material for reducing the free or forced vibration induced particularly in said shell (8), and so reducing structural noise propagation.

4. A panel as claimed in Claim 1, characterized in that said at least a first layer (16) comprises any one or a mixture of: glass fiber, rock fiber, loose expanded clay, expanded clay with chemical binders or cement, open-cell expanded plastic (polyurethane, polyester), waste rubber, sound-absorbing asphalt, porous cement.

5. A panel as claimed in Claim 3, characterized in that said at least a third layer (18) of damping material comprises any one or a mixture of: modified filled bitumen, modified filled butyl, high-density laminated plastic.

6. A panel as claimed in Claim 3, characterized in that said at least a third layer (18) of damping material rests directly on said shell (8).

7. A panel as claimed in Claim 1, characterized in that at least one of said ribs (13) has a T-shaped cross section.

8. A panel as claimed in Claim 1, characterized in that said ribs (13) are substantially twice the thickness of said sheet material.

9. A panel as claimed in one of the foregoing Claims from 1 to 3, characterized in that two adjacent ribs (13) define a container (11, 12) for containing said first layer (16) of sound-absorbing material.

10. A panel as claimed in Claim 4, characterized in that said sound-absorbing material is a spray-on material; said container (11, 12) being open laterally to receive said sound-absorbing material by spraying.

11. A panel as claimed in any one of the foregoing Claims, characterized in that said shell (8) is formed by rolling a sheet of zinc-plated steel; said shell (8) also being coated with a film of protective, substantially waterproofing material.

12. A panel as claimed in any one of the foregoing Claims, characterized in that said shell (8) is divided by said ribs (10, 13) into a number of longitudinal flat portions (14); each said flat portion (14) comprising X-, Y- or cross-shaped impressions (15) for increasing the bending resistance and sound-wave-damping capacity of said shell (8).

13. A panel as claimed in any one of the foregoing Claims, characterized by being defined axially by substantially parallelepiped end portions (7), and by comprising supporting members (10a, 13a) for connecting the panel in any axial position to two substantially vertical uprights (3).

14. A panel as claimed in Claim 13, characterized in that at least one of said ribs (10, 13) comprises said supporting members (10a, 13a) at said end portions (7).

15. A panel as claimed in Claim 14, characterized in that at least one of said supporting members (10a, 13a) is defined by an axial portion (10a, 13a) of the respective said rib (10, 13); said axial portion (10a, 13a) being parallel to said flat portions (14).

16. A panel as claimed in Claim 15, characterized in that said axial portion (10a, 13a) is an elongated supporting member of substantially the same length as said shell (8) to permit assembly regardless of a fixed center distance between the respective uprights (3).

17. A method of forming an acoustic insulating barrier (2) from a number of panels (1), characterized by comprising the steps of:

   (a) erecting a number of uprights (3) between the noise source and the region for insulation, so that said uprights (3) are equally spaced and parallel to one another, with respective grooves (5) substantially facing each other in pairs;
   (b) inserting a number of shells (8) one after the other from the top, with respective end portions (7) inside grooves (5) of adjacent said uprights (3);
   (c) sliding each said shell (8) downwards until

a respective bottom edge (10) contacts an anchor plate (4) or a top edge (10) of the shell (8) underneath;

(d) spraying appropriate sound-absorbing material inside said shell (8) to completely fill the containers (11, 12) of said shell (8) and so form a first layer (16);

(e) connecting said end portions (7) of each shell (8) permanently and in soundproof manner to the respective uprights (3); and

(f) spraying on a second layer (17) to cover the whole of said first layer (16).

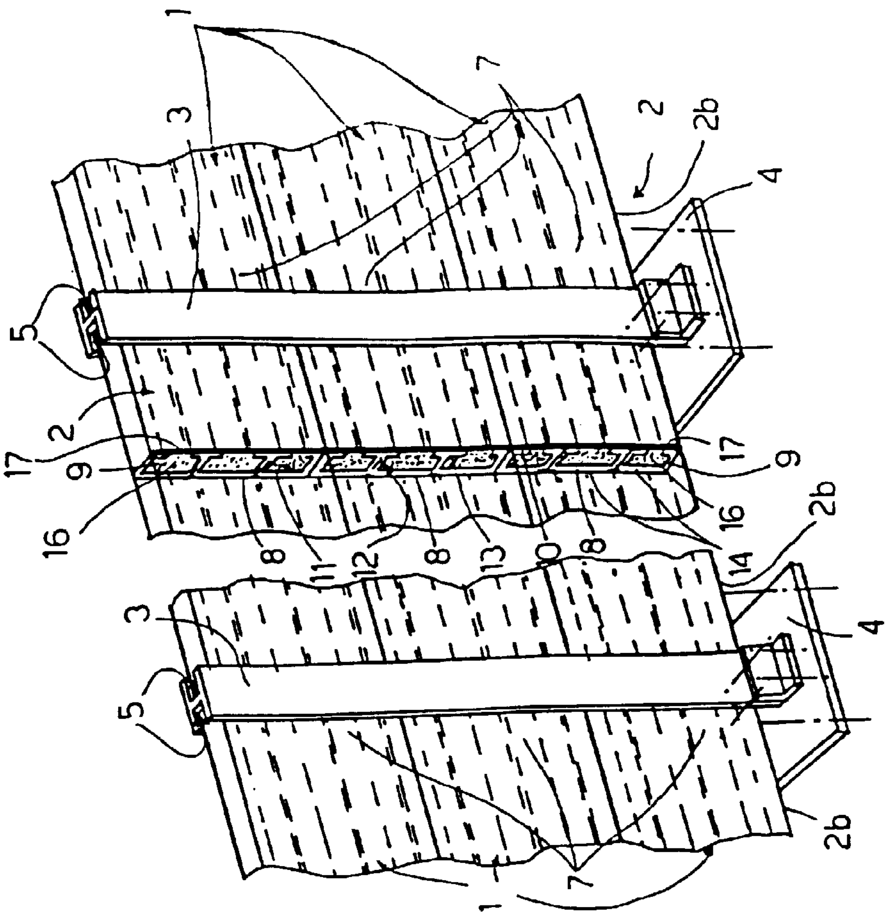
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Fig.2

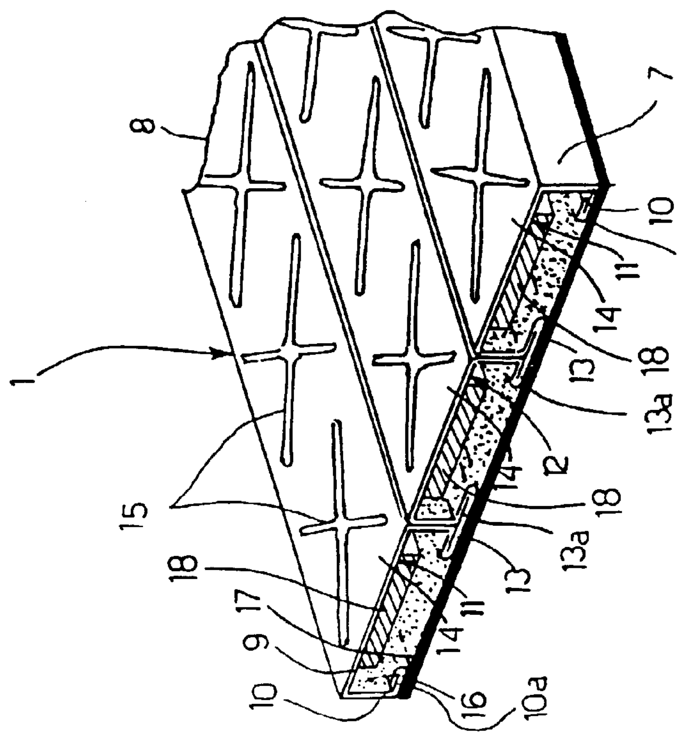
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Fig.1

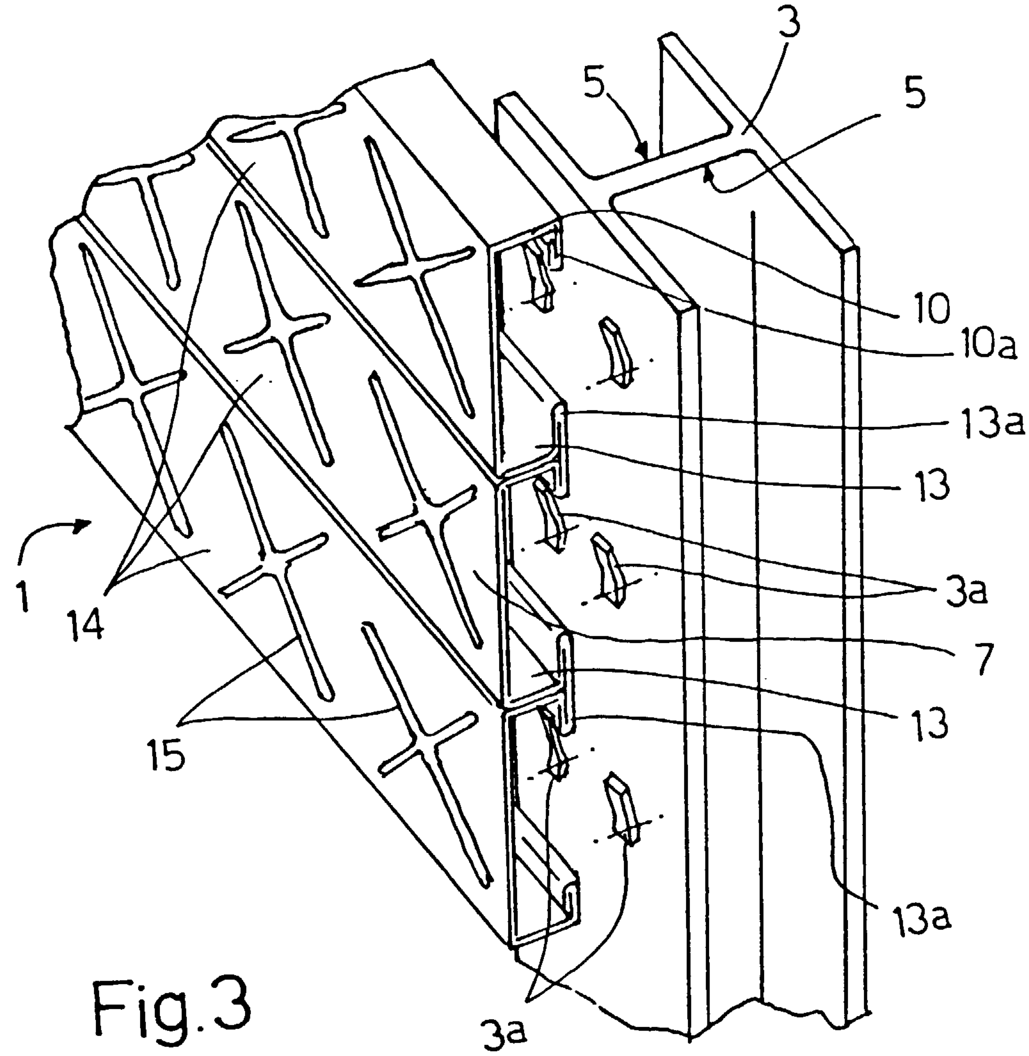

Fig.3

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EUROPEAN SEARCH REPORT

Application Number
EP 97 83 0612

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.6)
X Y	CH 672 932 A (MONTANA STAHL) * page 3, column 1, line 10 - line 35; figures *	1-4 6,17	E01F8/00
Y A	FR 2 120 702 A (LARMSCHUTZ BIERGANS) * page 10, line 24 - line 36; figure 3 *	6 1-5	
Y A	US 5 272 284 A (D.W. SCHMANSKI) * claim 16 *	17 1	
A	US 4 566 558 A (J.V. LINK) * column 2, line 30 - line 50 * * column 4, line 52 - column 5, line 18; figures 4,5 *	1-5,10, 17	
A	FR 2 311 146 A (R. JUDEAUX) * page 6, line 33 - line 40; figures *	1-5	
A	DE 29 35 745 A (BAUFA WERKE) * page 14, line 14 - line 17; figures 1,2 *	1,12	
A	US 4 495 240 A (B. MCCARTHY)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
E01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 February 1998	Verveer, D

CATEGORY OF CITED DOCUMENTS

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