Title: UNDERFOOT TACTILE SAFETY GUIDANCE SYSTEM

Abstract: A tactile guidance system for visually impaired persons comprises a thermoplastic layer having a raised pattern on its top surface, secured with an adhesive to certain pedestrian areas. The raised pattern is detectable to a person stepping thereon, whereby a visually impaired person will understand that they are approaching a potentially hazardous area, such as an intersection cross-walk or the edge of a railway platform.
UNDERFOOT TACTILE SAFETY GUIDANCE SYSTEM

TECHNICAL FIELD

This invention relates to a system for marking walking surfaces for the safety of persons walking thereon. More particularly, this invention relates to a system for marking walking surfaces to provide an underfoot tactile indication to persons walking at or near potentially hazardous areas.

Certain structures and areas intended for persons to walk upon nevertheless can pose potential dangers, and can be particularly dangerous for visually impaired persons. For example, railroad platforms are raised areas at train stations located adjacent the tracks and on which passengers and crew members walk when boarding or disembarking from railroad trains. The platform surface is generally at a level of a foot or more above the railroad tracks. Typically, there is no physical barrier at the edge of the platform to protect persons walking thereon from falling off the side of the platform and onto the tracks. Sighted persons will be able to see the edge of the platform and will be able to maintain a safe distance from the edge. Visually impaired persons who cannot see the edge of the platform will be in greater danger of stepping off the edge of the platform and falling onto the railroad tracks.

Other potentially hazardous areas can include certain sidewalk areas, especially near curbs, pedestrian cross-walks, and pedestrian walkways in public places adjacent stairways, escalators, and the like.
On railroad platforms, this problem has been addressed in the past by installing on platform edges a material having an uneven surface, or a surface that is otherwise noticeable by physical sensation when stepped upon, to provide a physical indication to visually impaired persons that they are approaching an edge of a railroad platform or other potentially dangerous area. Such a surface may have, for example, a corrugated-type pattern, or an uneven stone aggregate surface, that is readily distinguishable by the touch of one's footstep from the smooth surface of the main portion of the platform. Such surfaces, known as "tactile" surfaces, in the past have been formed from materials such as pre-formed concrete slabs or linoleum having a top surface with a pattern formed therein. Each of these materials has significant disadvantages for this purpose. Concrete slabs are heavy, making their installation time consuming and more labor-intensive. Concrete slabs have a substantial thickness, which may require that the surface on which the slabs are to be installed either be formed with a depressed ledge to accommodate the slabs, or undergo a pre-installation preparation to reduce the surface height to accommodate the slabs. Also, since the concrete slabs must be pre-formed, it is difficult to modify them at the installation site to accommodate irregularities in the platform configuration. Linoleum having a raised pattern on its top surface is lightweight and easy to install using either a water-based or solvent-based adhesive. Linoleum, however, poses a significant safety hazard in the event of fire, which can cause it to emit significant quantities of smoke and toxic fumes. For this reason, linoleum has been banned for use on railroad platforms in the United Kingdom. There is a need for a railroad platform safety marking system that will provide tactile underfoot guidance to visually
impaired persons at the edge of railroad platforms, will be easy to install and adaptable to a variety of installation configurations, and will not cause a safety hazard by emitting significant smoke or toxic fumes in the event of fire. There is also a need for an underfoot tactile guidance system for use on sidewalks, cross-walks, and public walkways, particularly in those areas that are hazardous for visually impaired persons.

It is thus one object of the invention to provide an underfoot tactile guidance system.

It is another object of the invention to provide an underfoot tactile guidance system which system is easy to install.

It is yet another object of the invention to provide an underfoot tactile guidance system which system is conformable to irregular configurations in the surface in which it is to be installed.

It is still another object of the invention to provide an underfoot tactile guidance system which system does not emit significant quantities of smoke or toxic fumes in the event of fire.

It is another object of the invention to provide a method for manufacturing an underfoot tactile guidance system.

It is another object of the invention to provide a method for installing an underfoot tactile guidance system.
Other objects, advantages, and novel features of the instant invention will be readily appreciated form the following description of a preferred embodiment of the invention.

DISCLOSURE OF THE INVENTION

In accordance with the invention, an underfoot tactile guidance system comprises a multi-layer structure comprising a layer of highly durable, pliant, preformed material having a raised pattern formed on the top surface thereof and installed in a potentially hazardous area in which persons may walk, the raised pattern being physically detectable to the footstep of a person stepping thereon, so that the person will be aware of stepping in a potentially hazardous area, even if the person cannot see the guidance system. In a preferred embodiment, a separate bottom layer of thermoplastic material of the hot-melt adhesive type is melted in place to the area to be marked. The molten thermoplastic bottom layer serves as an adhesive. One or more additional layers of material are placed on the molten bottom thermoplastic layer, the top surface of the one or more additional layers having the preformed raised pattern. The bottom layer is allowed to cool and solidify to provide a secure attachment between the raised pattern of the top surface and the area to be marked. The top layer of the guidance system can also be a hot-melt adhesive-type of thermoplastic, and can have the same or similar composition as the molten bottom layer. The multi-layer structure can also comprise layers of fabric or other thermoplastic materials, to impart improved tensile strength and tear resistance to the guidance system. In an alternative embodiment, the tactile guidance comprises preformed tiles or slabs having a raised pattern on the top surface thereof.
and a pressure-sensitive adhesive covered by a release liner on the bottom surface thereof.

The tactile guidance system of the invention can be cut and shaped to conform to a variety of configurations. Thus the guidance system can be adapted at the installation site to fit unique corners, angles, and other shapes as may be required. The top layer can be made skid-resistant, to provide surer footing in potentially hazardous areas. The top layer can also be provided with enhanced visibility, such as by the use of bright colors and/or retroreflective elements, to also serve as a visual guidance system for sighted persons.

MODE FOR CARRYING OUT THE INVENTION

In a preferred embodiment, the underfoot tactile guidance system of the instant invention comprises a multi-layer structure comprising a bottom layer of a thermoplastic material of the hot-melt adhesive type that can be melted in place, the top surface of the multi-layer structure being a preformed, durable, pliant material provided with a pre-formed raised pattern on at least one surface thereof, the pattern being of sufficient unevenness to be detectable to the footstep of a person stepping thereon. The material of the top layer can be a thermoplastic hot-melt adhesive, and can be the same composition as the material of the bottom layer, although other materials and compositions can be used. The term "raised pattern" as used herein is not intended to be limited to regular repeating intervals, but is intended to encompass any set of raised and lowered surfaces, of sufficient unevenness of height so as to be noticeable by a person stepping on the surfaces.
Thermoplastic visible marking systems for roadway surfaces are known in the prior art. One such system is produced and sold by the assignee herein under the name HotTape® preformed pavement markings for traffic control solutions, and is a hot-melt adhesive product used for providing stripes, arrows, and other visible legends on concrete and asphalt surfaces. Such a material is particularly advantageous because it does not emit significant quantities of smoke or toxic fumes in the event of fire. HotTape® pre-formed pavement markings have a substantially smooth top surface, and do not have a pre-formed raised pattern detectable to the footstep of a person.

An advantage of the instant invention is that the desired raised pattern is pre-formed in the top layer prior to installation, rather than at the job site. In accordance with the method of manufacturing the underfoot tactile guidance system of the instant invention, the raised pattern can be formed on the preformed thermoplastic material used in the instant invention by known means such as embossing. Other suitable methods of forming the raised pattern in the top layer include casting, molding, stamping, and impressions by a pattern wheel on an extruded layer of material.

In accordance with the method of installing the underfoot tactile guidance system of the instant invention, the bottom layer of hot-melt adhesive thermoplastic material is melted in place. The bottom layer material can be provided as preformed tiles or sheets that are laid in place and melted by an applied heat source, such as a propane torch or a heat gun. Alternatively, the material of the bottom layer can be provided at the installation...
site in a form such as powder or pellets, which are melted and extruded in the molten state in a layer directly on the surface to be marked. The tiles of the one or more additional layers having a raised pattern on the top surface thereof are then set on top of the molten bottom layer and pressed in place. The bottom layer is allowed to cool and solidify, whereby the tiles of one or more additional layers are secured in position, with the solidified bottom layer acting as an adhesive between the tiles and the surface on which they are installed.

The durable pliant material used in the one or more additional layers of the guidance system of the instant invention can be provided in a variety of sizes and dimensions in accordance with customer specifications. For example, the additional layers can be provided conveniently as tiles of dimension 400 mm x 400 mm, although other shapes and sizes can be used. The material of the top layer can be about 50-150 mils in average thickness, although thicker or thinner materials can be used in accordance with the requirements of particular installations. The raised pattern on the top surface of the top layer can have a depth variation above the 50-150 mils average thickness selected according to the customer's specification. The bottom layer of hot-melt adhesive thermoplastic can have an average thickness of about 30-90 mils.

In an alternative embodiment the tiles of preformed material can be provided on their bottom surface with a pressure-sensitive adhesive covered by a release liner. At the installation site the system can be installed by removing the release liner and pressing the tiles into place.
The underfoot tactile guidance system of the instant invention is lighter weight, and faster and easier to install than concrete tactile guidance systems of the prior art, which will result in substantial savings in labor and installation costs. The inventive guidance system is also readily adaptable to a wide variety of installation configurations, including curves, angles, and corner surfaces, because tiles of the durable pliant thermoplastic material can be cut to conform to any surface.

The use of a hot-melt thermoplastic adhesive in the tactile guidance system of the instant invention advantageously avoids the use of prior art water-based or solvent-based adhesive systems. The installation of the inventive tactile guidance system is less time-consuming and labor-intensive than prior art concrete systems. The tactile guidance system of the instant invention will be slightly raised with respect to the adjoining walking surface, but will not be so thick as to require the removal of a portion of the surface to which it is to be applied. If it is desired that the top surface of the inventive tactile guidance system be flush with the adjoining walking surface, then optionally a corresponding thickness can be removed from the guidance system installation surface prior to the installation of the bottom layer.

Although the instant invention is intended to provide tactile guidance to visually impaired persons, the system can also provide helpful guidance to sighted persons. The top layer can be provided with retroreflective elements such as retroreflective glass beads, to make the guidance system more visible, particularly at night. Glass beads can also serve to make
the surface of the top layer more skid-resistant. Other materials can also be incorporated into the top layer to improve skid-resistance. The top layer can also be provided with a colored pigment to improve visibility of the guidance system.

While described above as comprising a bottom layer of hot-melt adhesive thermoplastic and a top layer of thermoplastic material having a pre-formed raised pattern, the tactile guidance system may include additional layers to impart certain desired properties to the system. For example, a fabric layers can be used to provide improved tensile strength and tear resistance. Such additional layers advantageously can be pre-formed with the top layer as a composite structure which can then be applied to the molten bottom layer in a single step.

The thermoplastic material of the top layer can be the same or different from the thermoplastic hot-melt adhesive material of the bottom layer. In either case, the materials can be selected from materials that do not emit significant quantities of smoke or toxic fumes in the event of fire.

The tactile guidance system of the instant invention will find utility in those areas where persons walk and which are potentially hazardous. For example, the tactile guidance system can be installed along the edges of railroad platforms to alert visually impaired persons that they are approaching the edge of the platform. The tactile guidance system will also find utility on stair steps, walkways, parking lots, curbs, cross-walks, and other places that are potentially hazardous for visually impaired persons.
The composition of the tactile and adhesive layers may depend on the site at which the system is to be installed. For a system to be installed on a railroad platform, the tactile layer can comprise calcium carbonate filler in the amount of 60-85 wt%, and preferably 70-80 wt%; an alkyd resin in the amount of 7-15 wt% and preferably 8-10 wt%; a polyamide resin in the amount of 5-10 wt% and preferably 6-8 wt%; plasticizer in the amount of 3-8 wt% and preferably 4-6 wt%; cullets dropped on the top surface in the amount of 1.5-5 wt% and preferably 2-4 wt%; paraffinic wax in the amount of 1-4 wt% and preferably 1.5-2.5 wt%; anti-oxidant in the amount of less than 2 wt% and preferably less than 1 wt%, and pigment in the amount of less than 5 wt% and preferably less than 2 wt%. If the bottom adhesive layer is of the hot-melt type rather than the pressure-sensitive type, then the bottom layer can be of a composition substantially identical to the tactile layer except omitting the cullets. The pigment may impart a gray color, or any color desired for the particular environment.

In an alternative composition suitable for use at pedestrian cross-walks, the tactile layer can comprise calcium carbonate filler in the amount of 60-85 wt% and preferably 70-80 wt%; alkyd resin in the amount of 7-13 wt% and preferably 9-11 wt%; polyamide resin in the amount of 5-10 wt% and preferably 6-8 wt%; cullets dropped on the surface in the amount of 5-10 wt% and preferably 6-8 wt%; plasticizer in the amount of 2-4 wt% and preferably 2.5-3.5 wt%; paraffinic wax in the amount of 1-4 wt% and preferably 1.5-2.5 wt%; anti-oxidant in the amount of less than 2 wt% and preferably less than 1 wt%; and pigment in the amount of less than 5 wt% and preferably less than 2 wt%.
A hot melt adhesive layer suitable for use with the pedestrian cross-walks tactile layer can comprise calcium carbonate further in the amount of 60-85 wt% and preferably 70-80 wt%; alkyd resin in the amount of 10-16 wt% and preferably 12-14 wt%; polyamide resin in the amount of 6-10 wt% and preferably 7-9 wt%; plasticizer in the amount of 1.5-4.5 wt% and preferably in the amount of 2-4 wt%; paraffinic wax in the amount of less than 2 wt% and preferably less than 1 wt%; anti-oxidant in the amount of less than 2 wt% and preferably less than 1 wt%; and pigment in the amount of less than 2 wt% and preferably less than 1 wt%. For pedestrian cross-walks a buff colored pigment may be used, or any other color desired.

In both the tactile layer and adhesive layer, other materials can serve as equivalents for those listed above. The filler can comprise talc, mica, barytes, fiberglass, glass beads, cullets, all alone or in any combination with or without calcium carbonate, and with suspending agents, thickness, or extenders. In place of the alkyd resin, one could use hydro resins, polyester resins, maleic resins, phenolic resins, epoxy resins, or acrylic resins. Suitable equivalents for the polyamide resin include ethylene vinyl acetate, propylene vinyl acetate, and polystyrene. Instead of cullets, glass beads can be applied to the top surface of the tactile layer. Suitable equivalents for paraffinic wax include polyethylene wax and polypropylene wax. Other ingredients that can be used in both the tactile and adhesive layers include leveling agents, anti-corrosion agents, and UV stabilizers.

The following examples illustrate various embodiments of the instant invention.
Example 1

A quantity of Stimsonite HotTape® brand hot melt thermoplastic was melted to sufficient viscosity and drawn into a flat sheet to an average thickness of approximately 125 mils. A cylinder with a carved-in square pattern was rolled over the molten sheet. Water was sprayed onto the sheet while the cylinder was rolled and served as a mold release material between the cylinder and the molten flat sheet. As the cylinder was rolled, the square pattern was transferred into the molten sheet thus producing the tactile layer. The tactile layer was allowed to cool off and served as the top layer.

The bottom layer was a hot melt thermoplastic adhesive melted to sufficient viscosity to serve as an adhesive for the top tactile layer. The top tactile layer with the pattern formed thereon was not heated, but pressed firmly into the molten bottom layer and allowed to cool off.
Example 2

A quantity of Stimsonite HotTape® brand hot melt thermoplastic was melted to sufficient viscosity and drawn into a flat sheet to an average thickness of approximately 125 mils. This drawn sheet was allowed to cool. To this, a Teflon flat mold with specific round holes was laid on the cooled thermoplastic sheet. A molten hot melt adhesive was poured into the cavities of the Teflon sheet. Excess molten material was scraped off the Teflon sheets while still hot. The material was allowed to cool off, and the Teflon sheet was removed leaving the tactile pattern formed on the thermoplastic sheet. A silicone or other mold release agent can be used to aid in the demolding of the Teflon sheet. This tactile layer served as the top layer.

The bottom layer was a hot melt thermoplastic adhesive melted to sufficient viscosity to serve as an adhesive for the top tactile layer. The top tactile layer with the pattern formed thereon was not heated, but pressed firmly into the molten bottom layer and allowed to cool off.

Example 3

A quantity of Stimsonite HotTape® brand hot melt thermoplastic was melted to sufficient viscosity and drawn into a flat sheet to average thickness of approximately 125 mils. The drawn sheet was allowed to slightly cool off. A dollop of molten thermoplastic was poured onto the warm thermoplastic sheet forming a raised surface from the sheet. The dollop was repeated several times across the surface to form the tactile layer. This tactile layer served as the top layer.

The bottom layer was a hot melt thermoplastic melted to sufficient viscosity to serve as an adhesive to the top tactile layer. The top tactile layer with the
pattern formed thereon was not heated, but pressed firmly into the molten bottom layer and allowed to cool off.

**Example 4**

A quantity of Stimsonite HotTape® brand hot melt thermoplastic was melted to sufficient viscosity and drawn into a flat sheet to average thickness of approximately 125 mils. Round tabs were cut from a second sheet of hot melt thermoplastic. These round tabs were placed onto the melt thermoplastic sheet while the drawn sheet was still in a semi-molten state, thus creating a tactile layer. This served as the top layer.

The bottom layer was a hot melt thermoplastic melted to sufficient viscosity to serve as an adhesive to the top tactile layer. The top tactile layer with the pattern formed thereon was not heated, but pressed firmly into the molten bottom layer and allowed to cool off.
1. A tactile guidance system to be applied to a surface to provide a tactile signal to a person stepping thereon, the system comprising  
a first adhesive layer disposed on the surface;  
and  
a second layer disposed on top of said first adhesive layer, said second layer having a raised pattern formed on the top surface thereof, the raised pattern being physically detectable to the footstep of a person stepping thereon, said second layer comprising a thermoplastic composition.

2. The tactile guidance system of claim 1 wherein said first adhesive layer comprises a hot melt adhesive thermoplastic.

3. The tactile guidance system of claim 1 wherein said adhesive is a pressure-sensitive adhesive.

4. The tactile guidance system of claim 1 wherein said second layer comprises a hot melt adhesive thermoplastic.

5. The tactile guidance system of claim 1 wherein said second layer comprises a plurality of tiles.

6. The tactile guidance system of claim 5 wherein said second layer has an average thickness of about 50-150 mils.

7. The tactile guidance system of claim 2 wherein said first layer has an average thickness of about 30-90 mils.
8. The tactile guidance system of claim 1 wherein said top surface of said top layer further comprises a plurality of retroreflective elements.

9. The tactile guidance system of claim 1 wherein said top surface of said top layer further comprises a plurality of skid-resistant elements.

10. The tactile guidance system of claim 1 wherein said second layer further comprises a pigment.

11. The tactile guidance system of claim 1 wherein said second layer comprises more than one layer of material.

12. The tactile guidance system of claim 11 wherein said second layer comprises a layer of fabric.

13. The tactile guidance system of claim 1 wherein said second layer comprises a blend of filler, alkyd resin, and polyamide resin.

14. The tactile guidance system of claim 13 wherein said second layer comprises about 60-85 weight percent filler.

15. The tactile guidance system of claim 14 wherein said second layer comprises about 70-80 weight percent filler.

16. The tactile guidance system of claim 13 wherein said second layer comprises about 7-15 weight percent alkyd resin.
17. The tactile guidance system of claim 16 wherein said second layer comprises about 8-10 weight percent alkyd resin.

18. The tactile guidance system of claim 13 wherein said second layer comprises about 5-10 weight percent polyamide resin.

19. The tactile guidance system of claim 18 wherein said second layer comprises about 6-8 weight percent polyamide resin.

20. The tactile guidance system of claim 13 wherein said second layer further comprises one or more ingredients selected from the group consisting of plasticizers, waxes, anti-oxidants, and pigments.

21. The tactile guidance system of claim 13 wherein said filler comprises one or more materials selected from the group consisting of calcium carbonate, talc, mica, barytes, fiberglass, glass beads, and cullets.

22. The tactile guidance system of claim 1 wherein said thermoplastic second layer comprises one or more materials selected from the group consisting of alkyd resins, hydro resins, polyester resins, maleic resins, phenolic resins, epoxy resins, or acrylic resins.

23. The tactile guidance system of claim 1 wherein said thermoplastic second layer comprises one or more materials selected from the group consisting of polyamide resins, ethylene vinyl acetate polymer, propylene vinyl acetate polymer, and polystyrene.
24. The tactile guidance system of claim 1 wherein said second layer further comprises one or more ingredients selected from the group consisting of leveling agents, anti-corrosion agents, and UV stabilizers.

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25. The tactile guidance system of claim 1 wherein said first layer comprises a blend of filler, alkyd resin, and polyamide resin.

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26. The tactile guidance system of claim 1 wherein the composition of said first layer is substantially similar to the composition of said second layer.

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27. A method of applying a tactile guidance system to a surface comprising applying a first layer of molten thermoplastic adhesive to the surface;
applying a second layer onto said molten thermoplastic adhesive layer, said second layer having a preformed raised pattern formed on the top surface thereof, the raised pattern being physically detectable to the footstep of a person stepping thereon, said second layer comprising a thermoplastic; and allowing said molten thermoplastic adhesive layer to solidify.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPCG17: H04B 3/36; G01D 13/22; E01C 5/00; 11/02
US CL. : 340/407.1; 116/205; 404/34, 72
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)
U.S.: 340/407.1; 116/205; 404/34, 72

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)
EAST
search terms: tactile, massage, thermoplastic, tile, filler, resin

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tbody>
<tr>
<td>X, P</td>
<td>US 6,025,773 A (BRESNAN) 15 February 2000, figures 1-7, columns 5-6.</td>
<td>1, 2, 4, 7, 9-27</td>
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<td>Y, P</td>
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<td>Y</td>
<td>US 4,715,743 A (SCHMANSKI) 29 December 1987, fig. 1.</td>
<td>5, 6</td>
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<tr>
<td>Y</td>
<td>US 4,401,050 A (BRITT et al) 30 August 1983, abstract.</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>US 3,915,771 A (GATZKE et al) 28 October 1975, abstract.</td>
<td>8</td>
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<tr>
<td>A</td>
<td>US 5,409,925 A (WU) 25 April 1995, figure 1.</td>
<td>1-27</td>
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[X] Further documents are listed in the continuation of Box C. □ 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 published on or after the international filing date
  "L" - document which may throw doubts on priority claimed
  "Q" - 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

▲ "X" - document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

▲ "Y" - document of particular relevance; the claimed invention cannot be considered novel if combined with one or more other such documents, such combination being obvious to a person skilled in the art

Date of the actual completion of the international search
01 OCTOBER 2000

Date of mailing of the international search report
20 OCT 2000

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Form PCT/ISA/210 (second sheet) (July 1998)
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<th>Relevant to claim No.</th>
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<td>A</td>
<td>US 4,162,998 A (DOI et al) 31 July 1979, abstract.</td>
<td>1-27</td>
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<td>A</td>
<td>US 5,626,094 A (JEFFERY et al) 06 May 1997, abstract.</td>
<td>1-27</td>
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