The present disclosure relates to plastic composites which find use as decorative appliques for motor vehicle trim applications. An electroformed mold may be manufactured having a surface that provides a cast replication of a selected wood grain. The electroformed surface may then be placed into an injection mold and a plastic article may be formed thereon, thereby replicating the selected wood grain.
Published:
  — with international search report
3D FAUX WOOD APPLIQUE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of the filing date of U.S. Provisional Application Ser. No. 60/990,168, filed November 26, 2007, the teachings of which are incorporated herein by reference.

FIELD

This disclosure relates to plastic composites formed by injection molding, particularly to plastic composites which find use as decorative appliques for motor vehicle trim, and more particularly, to decorative appliques having a surface which replicates the grain pattern of wood, the surface provided by a mold surface which is a cast replicate of a real wood surface.

BACKGROUND

Transportation vehicles, particularly automobiles, are marketed and sold on the basis of differentiation over other competitive models. Differentiation may be by style or color, and is often accomplished by using trim panels or appliques on the interior or exterior of the vehicle which denote different levels of luxury, price or value. These appliques or panels may also form protective coverings for areas that protrude from adjacent surfaces. These panels are generally color-coordinated with the adjacent surfaces of the vehicle but may also be bright, reflective, wood-grained, marbleized or metallized in appearance.

Originally, appliques comprising real wood and finished metal panels were used, however, their popularity suffered due to their high cost and limited durability. Subsequently, wood veneers and films with vacuum-deposited metal layers found favor, however, these solutions did not produce the look of luxury, particularly a real wood grain pattern, or the extended durability required in today's market.

Various proposals have been suggested and practiced for the manufacture of plastic composites having the appearance of wood for use as automotive interior trim and exterior trim panels or appliques. One approach has been to form a paint film and inject a polymeric
material behind the paint film to produce a part with a desired color match on its exposed Class A surface. Examples of known paint film and injection molded plastic parts are disclosed in United States Patent Nos. 5,432,666 and 5,009,821. Such systems may require the separate manufacture and handling of the paint film. Furthermore, the outer surface being a paint film may not exhibit an exceptional depth of image and may be readily scratched or abraded. This approach also may not yield the depth and pattern of grain that may be found in real wood.

Various other proposals have been suggested to produce decorative trim parts and appliques which have unique decorative patterns, high distinctness of image (DOI) and exceptional "depth of image" which give the impression of luxury and high value. "Depth of image" is herein defined as the emphasis of a decorative pattern by a preferably clear resin layer overlying it, which provides the appearance that the pattern lies deep beneath the top surface of the clear outer layer. This is derived from wood finishing where multiple layers of wax or coatings may be applied and buffed out to provide a grain pattern that appears to lie well below the top surface or has depth.

For instance, United States Patent No. 5,338,592 is directed at laminating a series of wood veneers to form an overlay sheet, finishing, cutting and drying the overlay to form a shape, molding a transparent resin layer onto the front surface of the wooden shape and molding a synthetic resin core material onto the rear surface of a wooden shape. However, the effort of forming the wooden veneer overlay to the desired shape is both time consuming and costly. Further, the use of veneers provides an appearance of a grained surface but generally without a depth of grain, yielding a generally "flat", not three dimensional, appearance.

Similarly, United States Patent No. 5,525,179 is directed at manufacturing a lining part comprising a blank having a preformed shape and a cutout with an edge, injection molding a first plastic material to form a back surface, followed by injection molding a second plastic material to form a front surface coating which also coats the edges of the part. Again, a preformed shape without depth of grain is disclosed.

Regarding decorative wood articles, United States Patent No. 6,444,319 assigned to Erwin Behr, GmbH & Co. is directed at surface coating of an interior fitting for vehicles with a lacquer or resin layer wherein a wood veneer component is inserted into a mold and spaced from the cavity so that a liquid surface coating material having at least two mixed
components may be introduced into the space between the mold and wood veneer component. United States Patent Application Publications Nos. 2003/0044598 and 2003/0162045, also to Behr, disclose the use of a liquid coating material curable by UV radiation, and the application of a coating material based on vegetable-oil-modified resin and natural vegetable oils, with the addition to the coating material of ceramic micro-particles, respectively. Once again, a wood veneer is disclosed which may generally be lacking a depth of grain, like real wood.

Finally, United States Patent Application Publication No. 2002/0007898 is directed at a method of making a molded wood part having a wood grain pattern wherein a wood fiber substrate is formed, coated with a water-impermeable substrate and a pattern transferred to the substrate using a hydrographic process. A protective top coat may be applied over the pattern. One example of a hydrographic process is disclosed in United States Patent No. 4,010,057 wherein a thin film on which a pattern is printed is floated on the surface of a liquid and the pattern is transferred onto the surface of the object by submerging the surface of the object in the liquid.

While the various methods are suitable for their intended purpose, they all involve processing considerations that either produce emissions, require heavy capital investment in facilities or require unnecessary handling of one or more layers of material in the manufacture of a decorative exterior or interior trim product. These methods generally do not produce an exceptional depth of image of the decorative layer by forming a surface having a grain with depth like real wood. All suffer from the deficiency that the wood-appearing surface so formed does not possess a depth of grain and real wood grain pattern that may be found in a finished real wood article.

Thus, there is a continuing need in this field of art for an article and its method of manufacture that will have the a real wood grain and coloring which may be used to enhance the interior of a vehicle by providing a flowing appearance on the instrument panel, console, door panels, etc.

Accordingly, it is an object of the present invention to provide a method of providing trim panels or appliques having a real wood grained surface covered by an outer layer of injection molded clear plastic wherein the grained surface may be provided by replicating the grain of a real wood master.
It is a further object of the present invention to provide appliques and trim panels having a replicated real wood grained surface covered by an outer layer of injection molded clear plastic wherein the grained surface may be provided by replicating the grain of a real wood model.

It is a still further object of the present invention to form appliques and trim panels having a replicate of a real wood grained surface wherein the grained surface may be stained and finished like real wood to provide the distinctive appearance of real woods. Particularly, a rapidly drying/curing polymer composition may be applied while the injection mold is open, between injections, to color, stain or impart a desired visual effect to the grained surface of the molded article.

Still other objects and advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description, wherein it is shown and described preferred embodiments of the invention. As will be realized the invention is capable of other and different embodiments, and its several details are capable of modification in various respects, without departing from the invention. Accordingly, the description is to be regarded as illustrative in nature and not as restrictive.

**SUMMARY**

In a first aspect, the present disclosure is directed at a method for providing a trim panel or applique having a replicated real wood surface comprising providing a mold cavity having a surface which has been replicated from an original model comprising wood, placing the mold cavity in an injection molding machine along with a first mold cover/core, injecting a polymer into said mold cavity and mold cover/core; solidifying said polymer to form a plastic article having a wood grain, said wood grain having a surface, injecting a plastic material over the surface of said wood grain to form a protective layer, and removing said trim panel or applique having a replicated real wood surface from said mold.

In a second aspect, the present disclosure is directed at a method for forming a trim panel or applique having a replicated real wood surface comprising providing a wooden master in the shape of a trim panel or applique having a desired wood grain, casting a replication of said wood grain surface using silicone resin, casting a replication of said wood grain surface from said silicone resin using an epoxy polymer to form a plating mandrel,
coating said mandrel with a conductive coating. This may be followed by placing the mandrel into a plating bath, forming an electroformed mold cavity having a replication of said wood grain surface in said plating bath, placing said electroformed mold cavity in an injection molding machine along with a first mold cover/core, injecting a polymer into said electroformed mold cavity and mold cover/core, solidifying the polymer to form a plastic article having a wood grain, said wood grain having a surface, injecting a plastic material over the surface of said wood grain to form a protective layer, and removing the trim panel or applique having a replicated real wood surface from said mold.

In a third exemplary embodiment, the present disclosure relates to an applique comprising an injection molded polymer having a grained surface replicated from an original model comprising wood and over-molded with a protective plastic layer wherein the grained surface includes a stain which has been applied thereto before the protective plastic layer has been applied.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The features, operation and advantages of the invention may be better understood from the following detailed description of the preferred embodiments taken in conjunction with the attached drawings, in which

FIG. 1 is a perspective view of an automobile instrument panel including an applique of the present invention.

FIG. 2 is a schematic diagram illustrating the steps to prepare an injection mold and to form appliques from an electroformed mold having a real wood grain surface.

FIG. 3 is a cross-sectional view of a mold cavity for an injection mold including an electroformed mold having a real wood grain.

**DETAILED DESCRIPTION**

The present disclosure relates to a production method for providing a trim panel or applique having a replicated real wood surface wherein an electroformed mold may be manufactured having a surface which has been replicated from a wooden model, the electroformed mold may be placed in an injection molding machine to form a plastic article
having a wood grain, the surface of the plastic molded article may be stained or otherwise finished to yield the appearance of wood and a clear plastic may be injected to form a protective layer over the replicated wood grain.

In an exemplary embodiment, an electroformed mold may be placed into a cavity in an injection mold to support the electroformed mold against distortion during the injection molding process, the electroformed mold having a grained surface which is replicated from a section of real wood by casting.

In another exemplary embodiment, an applique is provided of molded plastic having a grained surface which is a cast replication of a real wood master provided by an electroformed mold. The grained surface of the applique may be finished with stains, etc. and coated with a clear protective top layer.

The plastic materials for forming the grained article and the protective layer of the molded applique may be of the same or different plastic composition, but preferably the protective layer may be a relatively clear transparent plastic which when provided at an appropriate thickness, yields an appearance that the grained surface lies well under the top surface of the clear layer, thus providing an exceptional depth of image.

In another exemplary embodiment, an apparatus is provided for forming appliques having a real wood grained surface by forming an electroformed mold as part of a replication process, the mold having a surface formed by casting a series of mirror images from the surface of a real wood master. The electroformed mold may then be placed into an injection mold to form molded articles having the same replicated grained surface.

The process to form the appliques according to the present disclosure may be carried out using multiple injection mold cores and covers to form the plastic layers on the electroformed mold surface and on the grained surface of the molded article. In one exemplary embodiment, the plastic article having a real wood grained appearance may be formed in one injection mold set and may travel with a first mold cavity to subsequently align with a second mold cover or core to provide a cavity space for molding the protective outer layer against the outer or grained top side of the molded article. Alternatively, the grained molded article may be demolded from the first mold set and placed in a second mold set having a cavity space which will allow the molding of a clear plastic material against the grained surface of the molded article.
Decorative panels in the form of appliques and bezels are found in many markets; automotive, appliance, marine, furniture, etc. Appliques and other trim panels, particularly for transportation vehicles, are used to enhance and differentiate the appearance of the vehicle and, on the interior, and even create an ambiance. The depth of the surface finish, whether wood grain or metal pattern, may make these panels appear more "real." Generally, decorative panels lack the three dimensional appearance or depth of surface provided by, for instance, the grain of a section of real wood. To provide a molded article having a surface with a three dimensional depth, such as a wood grain, one may replicate that surface by casting a series of positive and negative surfaces to form a mold surface.

By "replicate", it is meant that the physical characteristics of a surface, such as the pattern, depth and topography is reproduced from an original model or master to an article formed from a different and often synthetic material, such as plastic. This may often be accomplished by forming a mold from the surface of the original model or master, the mold being an exact but negative representation of the surface of the original model or master and then forming an article having an exact but positive representation of the surface by casting, injection molding, etc. onto the mold surface.

The present disclosure provides a process for producing appliques having exceptional decorative appearance and depth which replicates the surface, particularly the depth of the grain pattern of a section of real wood. An applique of this type is shown at 10 in Figure 1. FIG. 1 is a perspective view of the driver's side of an automobile cockpit with the main instrument panel 20 shown beneath a windshield 24. Beneath the instrument panel, typically, there is a hidden airbag deployment system 26 whose presence is not evident on the top surface. Decorating the surface of the instrument panel 20, are three coordinated appliques 10, 12 and 14 which include a wood grain pattern 16 that flows smoothly from panel to panel. Often this wood appearance flows completely across the instrument panel and along the door panels, along each side of the vehicle. By providing an applique with the appearance of an expensive wood, the interior appearance of the vehicle is enhanced and differentiated.

By "real" wood it is meant that the wood is naturally-occurring and may have a grain pattern formed over years of growth. The grain pattern may be enhanced by distressing or other surface treatment to emphasize the highlights of the naturally occurring grain pattern. The surface of the molded applique may be treated with a stain or other finish to further highlight the grain pattern much as a real wood surface may be treated. Further, the surface of
the molded applique may be provided with a relatively clear protective layer to provide protection damage due to abrasion and weathering and to provide the appearance of depth.

FIG. 2 is a schematic diagram of a process to form a mold surface which is a replicate of a grained surface having a three dimensional pattern, for instance, a piece of wood. It has been found that a plastic trim panel, or applique, having the appearance of a specific type and section of wood can be produced by solidifying a polymer on a mold surface which has been carefully replicated from a section of that specific wood. In one exemplary embodiment, the mold surface may comprise an electroformed nickel mold which may be constructed through a series of replications which ensure that the fidelity of the surface pattern of the desired wood surface (master) is transferred to the molded trim panel or applique.

As shown at 100 in FIG. 2, a section of wood (master) which has been cut to the shape of the final trim panel or applique and having the desired grain pattern and appearance is provided.

At 200, a casting of the section of wood may be taken using a material which has a very low degree of shrinkage, often room temperature vulcanizable (RTV) silicone. This casting process may be carried out under a vacuum to ensure that an exact replication of the surface of the wood is transferred to the surface of the RTV silicone. This now provides a negative image of the grained surface of the wood master.

At 300, a mandrel for forming an electroformed mold is produced by casting a replicate shape to the wood section from the surface of the negative replication formed at 200. This mandrel may be formed of a material capable of withstanding submersion in an electrolytic bath, such as a glass-filed epoxy, and may be coated with a paint which is electroconductive. Essentially, the epoxy mandrel replicates the size, shape and surface features of the original wood section, or master.

The coated mandrel may then be submerged in an electrolytic bath (at 400) and a metal part (mold) fabricated via an electroplating or electroforming process. The bath may include an anode, such as pure nickel which is to be transferred to the surface of the mandrel. The mandrel may act as a cathode and through the process of electrodeposition, metal ions may flow through the solution (electrolyte) from the anode to the cathode. In this manner, a metal skin may be built up on the surface of the mandrel, replicating the surface of the mandrel in fine detail. Once sufficient thickness has been built up on the mandrel to form an electroformed mold having a level of structural rigidity, for instance, about 0.080 to about
0.250 inches in thickness, the mold/mandrel may be removed from the bath (at 500) and the mandrel removed from the mold. This now may provide an electroformed mold having a surface which has replicated the grained surface of the real wood master in exacting detail.

As shown at 600, the electroformed mold may then be placed into the cavity of an injection mold. Generally, the electroformed mold may be backed by a layer of epoxy or low temperature melting metal to take up any differences in the shape of the back side of the electroform and the cavity of the injection mold, as the combination will be exposed to very high pressures during the injection molding process. A complementary mold cover or core may be provided to produce a cavity space, when mated to the electroform, for injecting a plastic material into and for forming a plastic article having the same shape and surface features as the original wood master. Upon injection of a suitable plastic, followed by cooling, the injection mold may be opened (800) and the grained surface of the molded article may be finished by staining, etc. An injection mold cover or core may then be mated to the cavity, leaving a small space, for instance less than about 0.100 inches, for a clear protective plastic to be injected and solidified (900). Subsequently, a plastic applique having a wood grain replicating the grained surface of a section of real wood may be formed upon removal from the mold (1000).

One advantage of the electroforming process is that it may reproduce the mandrel to within very close tolerances without the shrinkage and distortion associated with other forming techniques. Close dimensional tolerances and high fidelity surface finishes may be held and maintained on complex interior configurations. Through the electroforming process the precision and resolution inherent in the conductive patterned substrate of the mandrel may be reproduced into a mold surface to form a grained surface against.

FIG. 3 is a cross-sectional view of an injection mold 1 including a cavity portion 4 and a core or cover portion 2. An electroformed mold 5 may be formed as described above to include a grained surface 6 and engaged to the cavity portion 4. A plastic material may be injected into the mold 1 to form a molded article 3 having the mirror image grain of the electroformed mold surface 6. Subsequently, the grained surface of the molded article may be stained or otherwise finished and the mold 1 partially closed to allow a clear plastic material to be injected and form a protective layer 7 on the grained surface of the molded article 3.

The section of wood may include, but not be limited to, maple, oak, mahogany, birch, walnut, pine, elm, bamboo, ash, cherry, balsa, beech, boxwood, cedar, chestnut, cottonwood,
fir, hemlock, hickory, poplar, rosewood, spruce, sycamore, teak, cork or any other naturally-
occuring species. While the present disclosure is directed primarily at sections of wood to
form appliques, the process may work equally well to replicate a three dimensional surface of
another material such as metal having a desired three dimensional pattern.

The preferably clear protective outer layer may comprise any of the clear, preferably
light stable, plastics available in the art, including but not limited to, polycarbonate,
polymethyl-methacrylate, thermoplastic urethane, polyester, copolyester alloys, cyclic olefin
copolymer, poly-4-methyl-l-pentene, polysulphone, allyl diglycol carbonate, allyl ester,
styrene-acrylonitrile, polystyrene and polyvinyl chloride.

Appliques of the present invention may also preferably include fastening means for
attachment to other surfaces, including but not limited to, hook and loop, molded bosses
which interact with Palnuts, molded Xmas tree projections, and sections which snap-fit into
adjacent or mounting surfaces. These fasteners may be molded in place during the injection
molding process. Alternately, the fastening features may include dielocks, undercuts and
various other female features known in the art.

Other mold surfaces than electroformed nickel may be used, including but not limited
to, copper, nickel/copper or beryllium/nickel/copper electroforms. Metal molds may also be
formed by vapor deposition.

To color the molded article and emphasize the grain pattern, a stain such as one of the
KZ7 series from Allied Photochemical may be applied by spray, brush, roll, pad, dab, blot,
combinations thereof or other methods commonly known in the art, when the mold halves are
open and the grained surface is exposed. The stain or other coating may be in the form of a
liquid, powder, paste, gel, etc., to impart a desired effect such as color, gloss, texture, pattern,
repair, etc. Due to the rapid cycle times of the injection molding process, rapid drying or
curing coatings are preferred, having a high solids content (for instance between about 75 and
100% solids). In other words, the ingredients responsible for providing the actual coating are
present in a fluid system (e.g. a solvent) at concentrations of about 75-100% wt. Curing/drying to solidify the coating may take place due to the residual heat imparted during
the injection molding of the grained article or by irradiation from heaters, such as IR, UV,
heated air, etc. Since the cycle time for molding may be desired to be as short as possible
such that uptime on the press may be maximized, a robot with end-of-arm tooling may
deliver the application and curing equipment between the mold halves after the grained
article has been molded and the press opened. This may include spray guns, pads, brushes, lamps, or heaters.

The molded article may be formed from any one of a wide range of known plastic materials, such as ABS, PP, ABS/PC blends, PU, TPO, PET, PBT or other equivalent plastic materials suitable for injection molding into a product shape.
What is claimed is:

1. A method for providing a trim panel or applique having a replicated real wood surface comprising:
   a) providing a mold cavity having a surface which has been replicated from an original model comprising wood;
   b) placing said mold cavity in an injection molding machine along with a first mold cover/core;
   c) injecting a polymer into said mold cavity and mold cover/core;
   d) solidifying said polymer to form a plastic article having a wood grain, said wood grain having a surface;
   e) injecting a plastic material over the surface of said wood grain to form a protective layer; and
   f) removing said trim panel or applique having a replicated real wood surface from said mold.

2. The method of claim 1 wherein said plastic article having a wood grain surface is treated with a liquid to yield the appearance of real wood.

3. The method of claim 2 wherein said liquid comprises a stain, a paint, a colorant or a finish.

4. The method of claim 2 wherein said liquid is applied to said surface of said plastic molded article while said article remains in said mold cavity.

5. The method of claim 1 wherein said plastic material is transparent.

6. The method of claim 1 wherein said injecting said plastic material is carried out using a second mold cover/core, different than is used in forming said plastic article having a wood grain.
7. The method of claim 1 wherein said injecting of said plastic material is carried out using a second mold cover/core and a second mold cavity, different than what is used in forming said plastic article having a wood grain.

8. A method for forming a trim panel or applique having a replicated real wood surface comprising:
   providing a wooden master in the shape of a trim panel or applique having a desired wood grain;
   casting a replication of said wood grain surface using silicone resin;
   casting a replication of said wood grain surface from said silicone resin using an epoxy polymer to form a plating mandrel;
   coating said mandrel with a conductive coating;
   placing said mandrel into a plating bath;
   forming an electroformed mold cavity having a replication of said wood grain surface in said plating bath;
   placing said electroformed mold cavity in an injection molding machine along with a first mold cover/core;
   injecting a polymer into said electroformed mold cavity and mold cover/core;
   solidifying said polymer to form a plastic article having a wood grain, said wood grain having a surface;
   injecting a plastic material over the surface of said wood grain to form a protective layer; and
   removing said trim panel or applique having a replicated real wood surface from said mold.

9. The method of claim 8 wherein said surface of the plastic molded article having a wood grain is treated with a liquid to color said plastic molded article.

10. The method of claim 9 wherein said liquid comprises a stain, a paint, a colorant or a finish.
11. The method of claim 9 wherein said liquid is applied to said surface of said plastic molded article while said article remains in said electroformed mold cavity.

12. The method of claim 8 wherein said plastic material is transparent.

13. The method of claim 8 wherein said injecting of said plastic material is carried out using a second mold cover/core, different than is used in forming said plastic article having a wood grain.

14. The method of claim 8 wherein said injecting of said plastic material is carried out using a second mold cover/core and a second mold cavity, different than what is used in forming said plastic article having a wood grain.

15. The method of claim 8 wherein said wooden master having a desired wood grain comprises a wood that is naturally occurring.

16. The method of claim 15 wherein said naturally occurring wood is one of maple, oak, mahogany, birch, walnut, pine, elm, bamboo, ash, cherry, balsa, beech, boxwood, cedar, chestnut, cottonwood, fir, hemlock, hickory, poplar, rosewood, spruce, sycamore, teak or cork.

17. The method of claim 8 wherein said electroformed mold cavity comprises nickel.

18. The method of claim 8 wherein said plastic material forming a protective layer is less than about 0.100 inches in thickness.

19. The method of claim 8 wherein said plastic material forming a protective layer comprises one of polycarbonate, polymethylmethacrylate, thermoplastic urethane, polyester, copolyester alloys, cyclic olefin copolymer, poly-4-methyl-1-pentene, polysulphone, allyl diglycol carbonate, allyl ester, styrene-acrylonitrile, polystyrene and polyvinyl chloride.
20. An applique comprising:

   an injection molded polymer having a grained surface replicated from an
   original model comprising wood and over-molded with a protective plastic layer
   wherein said grained surface includes a stain which has been applied thereto before
   said protective plastic layer has been applied.
FIG-2

100
Provide wooden master with desired grain surface

200
Cast grained surface using RTV

300
Cast a mandrel from RTV and apply conductive paint to the grained surface

400
Place mandrel in bath and produce electroformed mold

500
Remove mandrel/mold from bath and remove mandrel from mold

600
Place electroformed mold into cavity of injection mold

700
Close mold, inject plastic to form article having same shape and grain as master

800
Open mold and apply stain, etc. to grained surface

900
Close mold and inject clear plastic over grained surface

1000
Allow molded part to cool and remove plastic appliqué having replicated wood grain from injection mold.
INTERNATIONAL SEARCH REPORT

International application No
PCT/US 08/85021

A CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B60R 13/02 (2009 01)
USPC - 296/146 7, 191, 108

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)
IPC(8) - B60R 13/02 (2009 01)
USPC - 296/146 7, 191, 108

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 296/70

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (PGPB, USPT, EPAB, JPAB), Google, Google Scholar
Search Terms trim panel, applique, plastic, polymer, injection molding, electroformed, nickel, stain, transparent, real wood wood grain, surface, plating mandrel, plating bath, silicone resin, epoxy polymer

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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<tr>
<td>Y</td>
<td>US 2005/00641 78 A1 (GRAY, J et al.) 24 March 2005 (24 03 2005) para [0002], [0004], [0010], [0017]-[0018], [0027], [0030]-[0031 ], [0033]-[0037], [0041], claims 2, 25</td>
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<td>Y</td>
<td>US 2007/0194487 A1 (NEITZKE, M) 23 August 2007 (23 08 2007) para [0002]-[0005], [0015], [0018]-[0019], [0020], [0022], [0043], [0046], [0048]-[0049], [0052], [0054]-[0055], [0058], [0060], [0062], [0064]-[0066]</td>
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* Further documents are listed in the continuation of Box C

* Special categories of cited documents
A" document defining the general state of the art which is not considered to be of particular relevance
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13 January 2009 (13 01 2009)

Date of mailing of the international search report
28 JAN 2009

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