(54) Title: RESIN PRODUCT COATING METHOD, APPARATUS AND RESIN PRODUCTS

FIG. 3 (a)

(57) Abstract: The invention is to provide a method of enabling to form the coated layer to be uniform thickness and concurrently form the surface to be uniform when forming the transparently coated layer on the surface. The invention makes the substrate plate by forming the substrate such as resins or metals into an appropriate shape and forming the upper mounted face thereof by adhering, coating or printing, subsequently laying the substrate plate in the forming die and pouring the liquid coating material into the inlet, and thereafter irradiating a light to the forming die from the outside to harden the coated layer. At this time, the forming die (1) defines the coating gaps of uniform thickness between the inner wall face of the forming die and the upper mounted face of the substrate plate laid inside thereof, and at the same time, (2) composes at least one part thereof with a translucent material for irradiating the light from the outside. Further, the coating material is prepared with (1) one-liquid hardening composition having fluidity enabling to fill the coating material in the coating gap, and (2) the composition hardening from liquid to solidity by irradiating the ultraviolet radiation and/or an electro-magnetic radiation.
DESCRIPTION

[Title of the Invention] Resin Product Coating Method, Apparatus and Resin Products

[Technical Field]

[0001]

The present invention relates to a coating method of resin-formed products for vehicle interior parts or furniture products, to resin-formed products treated with surface coatings by this method, and to an improvement of surface coatings for stoutly protecting upper mounted faces (surface layers) formed with upper mounted sheets such as natural woods or special metals.

[Related Prior Art]

[0002]

In general, ornamental panels have widely been employed as kinds of furnishings or vehicle interior products, otherwise exterior materials as domestic appliance. These ornamental panels are easy to process with less variances of shapes and are made with resins or metals to provide a mechanical strength meeting usage. For example, a substrate (core material) plate having the mechanical strength and dimensional precision is manufactured by inserting a reinforcing metal into a blank material made of resin, and an ornamental sheet is pasted on the plate surface for exterior designs.

[0003]

It has been known to emphasize specificity of the exterior design by pasting a sliced plate of the natural wood on the resin substrate as the ornamental sheet by means of the ornamental panel. For example, Patent Document 1 proposes the panel manufacturing method, decorating interior panels such as vehicle installment panels or console panels to be natural wood-finish patterns. This document discloses to decorate panel surfaces to be wood-finish patterns by pasting the sliced plate of the natural
wood on the resin blank material (substrate)

[0004]

Patent Document 1 discloses to manufacture the ornamental panel as a base plate by a molding die of a synthetic resin, paste an outermost sheet having the wood-finish pattern on the base plate and coat the uppermost layer with a transparent synthetic resin. This document does not disclose in detail how to paste the surface coated layer, but adheres a film shape sliced plate (200 to 500 µm) on a reinforcing material such as a veneer plate with an adhesive and adheres a transparent sheet (PC: polycarbonate) on the sliced plate via the adhesive (acrylic resin based adhesive).


[Disclosure of the Invention]

[Problems that the Invention is to solve]

[0005]

The decorative panel manufacturing method of pasting the decorative sheet on the surface of the panel substrate as the resin and forming an over-coat layer on its uppermost layer, employs respectively independent processes of producing base plates as resins or metals and decorative sheets made by printing, or of natural blank materials. The decorative sheet is dealt with printed patterns or patterns of natural blank material on the surfaces of intermediate reinforcing materials such as the resin, and coated on the uppermost face with the transparent resin.

[0006]

In the method of manufacturing the base plate and the upper mounted sheet in the respectively independent processes and finally pasting both by the adhesive, a following problem arises. The decorative film is formed by printing on the sheet or processing the natural blank material such as a woody material.
to be a sheet shape, and this sheet is fabricated with a very thin blank material for fitting to a complicated shape. For example, even if being the wood-finish sheet, the thickness is around 0.2 to 0.5 mm, and it is requested to be pasted not create wrinkles, irregularities or cracks in the panel substrate.

[0007] If pasting the decorative film formed with the very thin material to the panel substrate with the adhesive, the decorative film (uppermost layer) easily peels, distorts to curl, or creates wrinkles, cracks, pinholes or irregularities, so that a smoothness on the surface is spoiled. For example, if spoiling the smoothness on the surface owing to wrinkles or irregularities, even if its degree is extremely fine, when a user touches the surface, he feels it abnormal, and in case the uppermost layer is the natural material, depth is lost.

[0008] The decorative sheet has been so far formed on its surface with the transparently coated layer by coating, printing or pasting, and pasted on the panel substrate by the adhesive. Therefore, during the adhesion working, such a problem occurs that the decorative sheet itself including a surface coat generates wrinkles, irregularities or pinholes. Since the transparently coated layer is formed through the coating or printing procedures, it is formed with a comparatively thin layer and an outer appearance misses a depth after adhering. If forming this layer to be thick, cracks occur during the adhering process to the panel substrate, otherwise the transparently coated layer invites a discoloring problem owing to an internal strain caused by distorting deformation.

[0009] Therefore, the prior art adopted any one of following 1st
or 2nd methods when over-coating the panel substrate on the outer surface formed with the uppermost layer of the natural material such as a wooden material. At first, in the over-coating procedure, the natural material as the wooden material exposes in the surface, and it peels, or the natural material has to be avoided from degeneration or deterioration by heat, light or medical liquid. Therefore, an over-coating agent is requested to protect strength of the upper mounted layer as the natural material from degeneration or deterioration by peering or distortion, and concurrently to protect (guard) the upper mounted layer from degeneration or deterioration by heat, light, water or medical liquid.

[0010]
The 1st method employed conventionally as the over-coating procedure is to adhere the coated sheet to the panel substrate (pasting the base member and the natural uppermost material) prepared by a predetermined procedure where the coated sheet is formed with a transparently coated layer on a transparent resin film by, e.g., a silk printing, and is pressurized or heated to be pasted on the substrate surface. The coating process of pasting the coated sheet on the substrate surface is difficult to perfectly fit to the substrate surface of complicated configurations as concave and convex, and sometimes causes wrinkles or irregularities. For avoiding such cases, if heating to paste the sheet, a problem arises of degenerating the uppermost surface of the natural material.

[0011]
Further, as the over-coating procedure, the panel substrate is laid in the forming die, and the coating gap is defined between the uppermost layer and the die inner wall. Also known is a method of pouring the coating resin into the coating gap. In this case,
It is known, for example, that a heat plastic resin is heated and poured in the coating gap, and filled on the substrate surface, followed by cooling-solidification. However, the uppermost material (e.g., wooden material) is sometimes distorted or discolored owing to the temperature of the heated resin.

Therefore, as a method of solidifying the over-coating agent, not heating it, such a method has been tested of reacting the resin material filled in the coating gap and solidifying it. In this case, for filling the resin material having a desired over-coating facility into the die, a proposed method is to mix, for example, A liquid and B liquid immediately before filling into the coating gap. However, if mixing the resin materials and filling into the coating gap, the coating material begins solidification during pouring, and a problem occurs of not exactly permeating into the coating gap.

Then, inventors have reached an idea of shaping the substrate plate responsive to a usage, pasting the uppermost sheet thereon, then forming the film of transparently coated layer on the uppermost sheet by injection in order to avoid occurrence of wrinkles, irregularities or cracks, and enabling to obtain smoothness on the surface.

In this case, for injecting the coating material into the forming die to form the coated layer on the surface of the substrate plate inside, the inventors studied (1) not creating wrinkles, irregularities or cracks in the surface coated layer, (2) forming the surface coated layer to have a required thickness rich in waterproof, friction resistant feature, acid resistance (chemical resistance), and when solidifying the coated layer
formed by injection, (3) not causing discoloration or deterioration owing to changes of temperature or moisture by the heating treatment, and (4) not causing discoloration or deterioration in the coated layer owing to chemical change. [0015]

It is an object of the invention to provide a method of enabling to form the coated layer to be uniform thickness and concurrently form the surface to be uniform when forming the transparently coated layer on the surface.

Further, it is another object of the invention to provide a coating method accompanying neither a heating treatment nor a chemical change not causing discoloration or deterioration in the coated layer owing to chemical change, after injecting a material of fluidity into the forming die and forming the coated layer. [Means for solving the Problems]

For accomplishing the above mentioned problems, the present invention adopts the under mentioned means. By the way, the invention means the term of "one-liquid hardening composition" by such a substance, when hardening the coating material having fluidity, not hardening it by mixing two or more fluid substances but hardening one fluid substance (including the composition) by irradiating, for example, a light (ultraviolet radiation, infrared radiation or visible radiation). The invention makes the substrate plate by forming the substrate such as resins or metals into an appropriate shape and forming the upper mounted face thereof by adhering, coating or printing, subsequently laying the substrate plate in the forming die and pouring the liquid coating material into the inlet, and thereafter irradiating the light to the forming die from the outside to harden the coated layer. At this time, the forming die (1) defines
respectively the coating gaps of uniform thickness between the inner wall face of the forming die and the upper mounted face of the substrate plate laid inside thereof, and at the same time, (2) composes at least one part thereof with a translucent material for irradiating the light from the outside. Further, the coating material is prepared with (1) the hardening composition of one-liquid hardening composition having fluidity enabling to fill the coating material in the coating gap, and (2) the composition hardening from liquid to solidity by irradiating the ultraviolet radiation and/or an electro-magnetic radiation.

[Brief Description of the Drawings]

[0017] [Figure 1] illustrating a resin-formed product according to the invention, (a) is a perspective view showing an outer appearance, (b) is an explanatory view of a cross-sectional structure, and (c) is explanatory views of laminated structures;

[Figure 2] is an explanatory view of a whole structure of the coating apparatus of the invention;

[Figure 3] is explanatory views, (a) is an explanatory view of a cross-sectional structure along X-X line of Figure 2, and (b) is a partially enlarged view of (a);

[Figure 4] is an explanatory view of a cross-sectional structure along Y-Y line of Figure 2, and

[Figure 5] is explanatory views of the coating process of the invention.

[0018] The invention is concerned with the method of forming the coated layer 20 on the surface of the substrate plate 10, composed of a process of forming the upper mounted face 12x on the surface of the substrate formed into an appropriate shape and forming the substrate plate, a process of placing the substrate plate into
the forming die, a process of pouring the liquid coating material from the inlet 33 provided in the forming die and forming the coated layer on the upper mounted face of the substrate plate, and a process of irradiating the light to the outside of the forming die and hardening the coated layer.

[0019]
The forming die 20G is composed by (1) forming a coating gap of substantially uniform thickness between its inner wall face 31x and the upper mounted face 12x of the substrate plate 10 placed inside thereof, and (2) forming at least one portion of the coating gap with a translucent material for irradiating the light to the outside of the coating gap, and the coating material is prepared with (1) a hardening composition of one-liquid hardening composition having fluidity enabling to fill the coating material in the coating gap, and (2) the composition hardening from liquid to solidity by irradiating an ultraviolet light and/or an electromagnetic light.

[0020]
The coating method of resin products is set forth in claim 1, where the inlet 33 formed in the forming die is connected to a supply tank 36 of the coating material via a supply pipe, and the supply tank is equipped with a pressure pump unit 35 of pressurizing the coating material and guiding to the inlet.

[0021]
The forming die is structured with a core type 30 having a concave part 30U for receiving the substrate plate 10 and a cavity die 31 shielding to form the coating gap in relation with the upper mounted face of the substrate plate received in the concave part, and the cavity die and the core die are connected with air-tightness, and the coating gap is conducted to a vacuum pump unit 40 for reducing gas pressure within the coating gap.
The substrate plate 10 is pasted on the upper mounted face 12x with a wood-finish sheet generated from a natural wood.

The forming die is structured with the core die 30 having the concave part 3OU for receiving the substrate plate 10 and the cavity die 31 for forming the coating gap 2OG in relation with the upper mounted face of the substrate plate received in the concave part, and the cavity die is formed with the glass or the translucent material. The core die is structured with a steel, stainless steel or aluminum alloy.

The core die (30) is composed of the steel, and the concave part 3OU receiving the substrate plate 10 is surface-treated with a hard chromium plating.

The coating material is a polyurethane or acrylic resin containing a sensitizing substance as a component sensitive to the ultraviolet light, and is poured in the forming die, not being mixed immediately before pouring.

The forming die is furnished with a heating unit 41 for heating the coating material poured inside thereof, and the heating unit heats the coating material poured inside of the forming die up to a predetermined temperature when irradiating the ultraviolet light and/or the electromagnetic light to the forming die.

A resin-formed product such as a vehicle interior panel is formed by comprising a substrate plate 10 formed with an upper mounted face on the surface of a resin substrate appropriately
formed and a transparent or semitransparent coated layer 20, and the coated layer is formed by pouring the coating material of one-liquid photo-curing composition on the upper mounted face of the substrate plate received in the forming die, and subsequently irradiating an ultraviolet ray and/or an electromagnetic radiation ray to the outside of the forming die.

[0028]

A coating apparatus for forming a coated layer 20 on the surface of a resin-formed product provides a forming die having a concave part 30U for receiving a substrate plate 10 inside thereof, a liquid coating material to be poured into the forming die, and an emission device 41 of irradiating an ultraviolet light and/or an electromagnetic radiation light to cure a coating material poured in the forming die, and the forming die is composed by (1) forming a coating gap of substantially uniform thickness between its inner wall face 31x and the upper mounted face 12x of the substrate plate placed inside thereof, and (2) forming at least one portion of the coating gap with a translucent material for irradiating the light to the outside of the coating gap, and the coating material is prepared with (1) a hardening composition of one-liquid hardening composition having fluidity enabling to fill in the coating gap 20G, and (2) the composition hardening from liquid to solidity by irradiating an ultraviolet light and/or an electromagnetic light.

[Effects of the Invention]

[0029]

The invention forms the uppermost face on the substrate having the appropriate shape responsive to usage, forms the surface of the substrate plate with the coating material of one-liquid ultraviolet light hardening type (and/or electromagnetic hardening radiation) poured in the forming die, and then
irradiates the ultraviolet radiation (and/or electromagnetic radiation) from the outside of the forming die to harden the surface. Therefore, the invention has the following characteristics.

The forming die is formed with the determined coating gap in relation with the surface of the substrate plate received inside of the forming die, and since the coating material is poured into this gap and photo-cured thereafter, the surface coated layer is not generated with wrinkles, irregularities or cracks. Accordingly, the coated layer on the surface is performed with coating the surface of the substrate plate under the smoothness and air-tightness rich condition, and displays the characteristics excellent in water-proof and chemical resistance.

At the same time, the surface coated layer can obtain an aesthetic appreciation, in particular, the depth by controlling thickness of the coating gap.

Since the coating material is composed of one-liquid hardening composition, it does not accompany the chemical reaction when hardening the liquid to the solid, and can secure transparency and uniformity.

Further, when pouring the coating material into the forming die, if reducing pressure the coating gap (space) formed between the die inner wall and the surface of the substrate plate to vacuum, no bubbles are involved when pouring the coating material. If injecting the coating material under pressure from the inlet at the same time with reduction of pressure of the coating gap, air bubbles can be further avoided from occurrence.

[Most preferred Embodiment for practicing the Invention]
In the following, the invention will be stated in detail based on the illustrated suitable embodiments. Figure 1 illustrates a resin-formed product A according to the invention, where (a) is the perspective view showing an outer appearance, (b) is the explanatory view of the cross sectional structure, and (c) is explanatory views of laminated structures; Figure 2 is the explanatory view of the whole structure of the coating apparatus B; and Figure 3 is the explanatory views of the elementary part of Figure 2, where (a) is the explanatory view of the cross sectional structure along X-X line of Figure 2, and (b) is the partially enlarged view of (a). The invention will be explained in the order of "resin-formed product", "coating process" and "coating device".

[0034]

[Resin-formed product]

At first, explanation will be made to the resin-formed product A of the invention. The resin-formed product A shown in Figure 1 is composed of the substrate plate 10 and the coated layer 20 formed on the surface of the substrate plate 10. The substrate plate 10 has the substrate 11 and the upper mounted face 12 formed on the surface of the substrate 11.

[0035]

The substrate 11 is formed with a synthetic resin or a metal in response to usage such as the interior panel. The shown substrate 11 is formed in plate by the molding die of the synthetic resin, and a metal reinforcing material (not shown) is inserted inside for satisfying usage. The substrate 11 is composed to a material of the metal, wooden material or woven material other than the resin in order to shape meeting usage.
The upper mounted face 12 forms a decorative face (surface treatment; a first embodiment) directly on the surface of the substrate 11 by plating, coating or printing, otherwise adheres the decorative sheet 12S on the surface of the substrate 11 by the adhesive 13b. The shown resin-formed product A shows a case of pasting the decorative sheet 12S to the substrate 11 by the adhesive 13b as shown in Figure 1(c).

The decorative sheet 12S is composed of a flexibly sheet-like film material. The uppermost material 12b is pasted to a reinforcing plate 12a by the adhesive 13b. The reinforcing plate 12a is made of, for example, a veneer plate, non-woven fabric or resin film. The illustrated reinforcing plate 12a is the veneer plate of 0.5 mm thickness. The uppermost material 12b is composed of the film material formed with the upper mounted face (design face) 12x by printing or a sliced material of the natural blank material. The illustrated one is the upper mounted material 12b of the wood-finish upper mounted sheet of the natural wood. Therefore, the uppermost material 12b is the material sliced in plate of 200 to 500 µm thickness, and adhered to the reinforcing material 12a by the adhesive 13b.

Other than the above mentioned, the decorative sheet 12 may be composed of the simplex uppermost material 12b, not using the reinforcing plate 12a and in such a case, the uppermost should be selected from materials being easily deformable and having a desired mechanical strength. Further, other than forming the upper mounted sheet with the natural wood, a thin material (flexible sheet) is formed in response to usage, for example, with metals or carbon, and the upper mounted sheet may be composed of such thin plates.
Next, explanation will be made to the coated layer 20. As mentioned above, the substrate 11 as the resin is pasted on its surface with the upper mounted sheet layer 12S. The upper mounted sheet 12S is covered with a transparent (translucent) coated layer 20. The substrate 11 of the upper mounted finish is coated on its uppermost face with a polymer. The polymer is transparent, for example, an acrylate polymer, and selected from a pinch- and- swell rich material. As shown in Figure 1 (c), a polymer layer 12p is coated on the upper mounted sheet layer 12S. The polymer layer 12p is a transparent resin material of thickness (t mm). The quality of the polymer layer and coating thickness (film thickness) are condensed when the coated layer 20 is hardened by UV light as later mentioned. In regard to the quality (in particular, the pinch- and- swell feature) of the polymer layer and coating thickness, optimum values are obtained experimentally not to generate voids between the upper mounted and the coated layer 20 by condensation of the coated layer 20.

Therefore, the coated layer 20 is formed on the highest layer of the substrate plate 10 of a predetermined shape. The coated layer 20 is composed of the transparent or translucent resin material at a degree of exposing the upper mounted face 12x outside. The resin material (called as "coating material" hereafter) is injection-formed into the coating gap 20G formed between the surface of the substrate plate 10 and the inner wall of a forming die (later mentioned). The coating material is made of one-liquid photo-curing type resin material.

[Coating device]

Next explanation will be made to the coating device B shown
in Figures 2 and 3. The coating device B is composed of a core
die 30 and a cavity die 31, and the cavity die 31 is formed with
a concave part fitting an outer diameter shape of the substrate
plate 10. Between the die inner wall 31x and the upper mounted
face 12x, the coating gap 2OG is defined. The coating gap 2OG
is previously determined to be thickness of the coated layer
formed on the surface of the substrate plate 10. Further, the
core die 30 is formed with a concave groove in response to the
shape of the substrate plate 10.

[0042]

In regard to the cavity die 31, stepwise flanges 31f (refer
to Figure 3 (b) ) are provided at several parts of the periphery
of the substrate plate 10, and by means of the stepwise flanges,
the substrate plate 10 is held between the core die 30 and the
cavity die 31. Numeral 38 designates a closing bolt. The coating
gap 2OG defined between the core die 30 and the cavity die 31 is,
as shown in Figure 2, connected to an injection nozzle 33, inflow
path 34, compressor 35 and coating material supporting tank 36.

[0043]

Accordingly, by working the compressor 35, the liquid
coating material supported in the tank is pressurized by the
compressor 35 and flows from the injection nozzle 33 into the
coating gap 2OG.

[0044]

The coating gap 2OG defined between the core die 30 and the
cavity die 31 is provided with a discharge opening 37 which is
connected to a vacuum pump 40 via the inflow path 39. Therefore,
by working the vacuum pump 40, a gas staying in the coating gap
2OG get out from an outlet 37.

[0045]

With respect to the injection nozzle 33 and the outlet 37
formed in the coating gap 20G, as shown in Figure 2, the inlet (nozzle 33) of the coating material is positioned at the lowermost end in the gravity acting direction (refer to an arrow in Figure 2) while the outlet 37 is positioned at the uppermost end in the same direction. Accordingly, bubbles caused within the coating gap 20G floats upward in a reverse gravity acting direction, and concurrently the cavity inside is decompressed into a vacuum state. Bubbles pass through the inflow path 39 from the outlet 37 and flows outside of the forming die.

The cavity die 31 is composed of the transparent glass (for example, quartz glass) or a translucent material at the at-least position directing to the coating gap 20G so that the ultraviolet light can be radiated to the coating gap 20G. 3Iy in Figure 3 designates a translucent window. The coating gap 20G composed of the cavity die 31 and the core die 30 is provided with the translucent window 3Iy for enabling to radiate the light from the outside of the die, and an ultraviolet lamp (UV lamp) 41 is arranged outside of the translucent window 3Iy. After filling the coating material into the coating gap 20G, a source of the UV lamp 41 is applied conductively to irradiate the ultraviolet light toward the coating gap 20G.

Since the coating material irradiated with the ultraviolet light from the UV lamp 41 contains an ultraviolet absorber and an ultra violet curing agent, it receives UV light (for example, 300 nm wavelength) and hardens from the liquid state to the solid state. The coated layer 20 having a photo polymerization initiator cured by the ultraviolet light does not discolor even if being exposed to the ultraviolet light for a long time after forming.
The detailed structure of the above mentioned coating device B will be explained. As shown in Figure 2, the forming die (core die 30 and cavity die 31) is installed in the vertical direction in the length of the substrate plate 10. On the basis of the gravity acting direction, the injection nozzle 33 is arranged at the lower side while the discharge opening 37 is arranged at the upper end. The inflow path 34 communicating with the injection nozzle 33 is provided with a check valve (not shown). The compressor 35 is composed of an ordinary discharge nozzle, and pressurizes the liquid coating material in the coating material tank to guide to the injection nozzle 33.

The discharge opening 37 is, as mentioned above, connected to the inflow path 39, to which a vacuum pump 40 is disposed. The inflow path 39 is provided with a check valve (not shown). The injection nozzle 33 and the discharge opening 37 are placed at a position communicating with the coating gap 20G. Accordingly, the gas in the coating gap is sucked by a vacuum pump 40 from the discharge opening 37, and the coating material is introduced from the injection nozzle 33. Even if bubbles are contained in the coating material flowing into the coating gap, those are removed by the vacuum pump 40 from discharge opening 37 outside of the forming die. Thereby, the coated layer 20 is filled in the coating gap 20G and photo-cured, and no bubbles are generated.

Following the process explaining view of Figure 4, the coating process according to the invention will be explained. At first, the coating process of the invention is composed of "process preparing plate of the blank material" and "coated layer
In the process preparing plate of the blank material, the upper mounted sheet 12S is formed by slicing a natural blank material, for example, the natural wood having distorting and flexibility rich thickness (St11). The reinforcing plate 12a is prepared (St12) in parallel to forming of the upper mounted sheet 12S, and this is used for mechanical reinforcement back-up supporting the upper mounted sheet 12S and avoiding degeneration of the upper mounted sheet 12S. In the illustrated one, since the decorative sheet 12S is formed with the wood-finish sheet, the reinforcing plate 12a is formed with the veneer plate for maintaining durability of the wood-finish sheet.

Subsequently, the reinforcing plate 12a is pasted with the upper mounted sheet 12S by the adhesive 13b. Then, if needing, pressure is effected while heating. The reinforcing plate 12a and the upper mounted sheet 12S are laminated each other into one body (St13) as a film. The reinforcing plate 12a made of the wooden material protects as backing up the wood-finished upper mounted sheet 12S with the same materials in the water-holding property and in the temperature and moisture change.

Next, the substrate 11 is made (St14). The substrate 11 is formed in response to usage by molding the resin. For example, in case of the interior panel of the car, the substrate is formed in view of a purpose. Then, if needing, the reinforcing material is subjected to an in-mold form. The substrate 11 formed in shape and with the mechanical strength responsive to the purpose is pasted on its surface with the upper mounted sheet 12S by the
adhesive 13b (St15). The substrate 11 of the upper mounted finish under this condition is accomplished (St20a). The substrate 11 is coated on its surface with the resin polymer to form the surface film of polymer (St20b).

[0054]

[Coated layer forming process]

The coated layer forming process forms the coated layer on the surface of the substrate plate 10. The forming die is, as mentioned above, composed of the cavity die 31 and the core die 30, and turns out one body by the closing bolt 38. Then, the cavity die 31 and the core die 30 are separated (St21). Subsequently, the core die 30 is set in its concave part 30U with the substrate plate 10, and the substrate plate 10 is covered on its top with cavity die 31. At this time, the stepwise flange 31f of the cavity die 31 knocks to regulate the upper mounted face 12x of the substrate plate 10, so that the coating gap 2OG is defined between the upper mounted face 12x and the die inner wall 31x.

[0055]

The core die 30 and the cavity die 31 are closed into one body by the closing bolt 38 and the air-tightness of the coating gap 2OG is maintained (St22). In the coating material tank 36, the above mentioned one-liquid coating material is stored. The coating material is controlled at a desired temperature, for example, 38°C (St23). The vacuum pump 40 is actuated to absorb air in the coating gap 2OG into the vacuum state (St24). Then, the compressor 35 is worked to pour the coating material into the coating gap.

[0056]

By pouring the coating material into the coating gap 2OG and actuating the vacuum pump 40, the substrate plate is formed on its surface with the coated layer 20 of the desired thickness
Bubbles are not generated in the coated layer. The ultraviolet light is irradiated from the translucent window 31 of the cavity die 31 (St26). By irradiating the ultraviolet light, the coating material filled in the coating gap 20G is hardened to change from the liquid to the solid state. After hardening, the substrate plate 10 is taken out from the forming die, and the coating process is finished (St27).
CLAIMS

[Claim 1]
A coating method of resin products, which is a method of forming a coated layer on a surface of a substrate plate, characterized by comprising

- a process of forming an upper mounted face on the surface of a substrate appropriately formed to prepare the substrate plate,
- a process of placing the substrate plate into a forming die,
- a process of injecting a liquid coating material from an inlet formed in the forming die to form the coated layer on the upper mounted face of the substrate plate, and
- a process of irradiating a light to the outside of the forming die to cure the coated layer,

the forming die is composed by

1. forming a coating gap of substantially uniform thickness between its inner wall face and the upper mounted face of the substrate plate placed inside thereof, and
2. forming at least one portion of the coating gap with a translucent material for irradiating the light to the outside of the coating gap, and

the coating material is prepared with

1. a hardening composition of one-liquid hardening composition having fluidity enabling to fill the coating material in the coating gap, and
2. the composition hardening from liquid to solidity by irradiating an ultraviolet light and/or an electromagnetic light.

[Claim 2]
The coating method of resin products as set forth in claim 1, characterized in that the inlet formed in the forming die is
connected to a supply tank of the coating material via a supply-pipe, and the supply tank is equipped with a pressure pump unit of pressurizing the coating material and guiding to the inlet.

[Claim 3]

The coating method of resin products as set forth in claim 1, characterized in that the forming die is structured with a cavity die having a concave part of receiving the substrate plate and a core die of shielding to form a coating gap in relation with the upper mounted face of the substrate plate received in the concave part, and the cavity die and the core die are connected with air-tightness, and the coating gap is conducted to a vacuum pump unit for reducing gas pressure within the coating gap.

[Claim 4]

The coating method of resin products as set forth in claim 1, characterized in that the substrate plate is pasted on the upper mounted face with an upper mounted sheet generated from a natural wood, metal thin sheet or a carbon thin sheet.

[Claim 5]

The coating method of resin products as set forth in claim 1, characterized in that the forming die is structured with the core die having the concave part for receiving the substrate plate and the cavity die for forming the coating gap in relation with the upper mounted face of the substrate plate received in the concave part, and the cavity die is formed with a glass or other translucent material.

[Claim 6]

The coating method of resin products as set forth in claim 5, characterized in that the core is structured with a steel, stainless steel or aluminum alloy.

[Claim 7]

The coating method of resin products as set forth in claim
5, characterized in that the cavity die is composed of the steel, and the concave part receiving the substrate plate therein is surface-treated with a hard chromium plating.

[Claim 8]

The coating method of resin products as set forth in claim 1, characterized in that the coating material is a composition being a main component of a polyurethane or acrylic resin.

[Claim 9]

The coating method of resin products as set forth in claim 1, characterized in that the coating material contains a sensitizing substance as a component sensitive to the ultraviolet light, and is poured in the forming die, not being mixed immediately before pouring.

[Claim 10]

The coating method of resin products as set forth in claim 1, characterized in that the forming die is furnished with a heating unit for heating the coating material poured inside thereof, and the heating unit heats the coating material poured inside of the forming die up to a predetermined temperature when irradiating the ultraviolet light and/or the electromagnetic light to the forming die.

[Claim 11]

A resin-formed product such as a vehicle interior panel, characterized by comprising

- a substrate plate formed with an upper mounted face on the surface of a resin substrate appropriately formed and
- a transparent or semitransparent coated layer, and

the coated' layer is formed by pouring a coating material of one-liquid photo-curing component on an upper mounted face of the substrate plate received in the forming die, and subsequently irradiating an ultraviolet light and/or an electromagnetic
A coating apparatus for forming a coated layer on the surface of a resin-formed product, characterized by providing a forming die having a concave part for receiving a substrate plate inside thereof, a liquid coating material to be poured into the forming die, and an emission device of irradiating an ultraviolet light and/or an electromagnetic radiation light to cure a coating material poured in the forming die, the forming die is composed by

1. forming a coating gap of substantially uniform thickness between its inner wall face and the upper mounted face of the substrate plate placed inside thereof, and
2. forming at least one portion of the coating gap with a translucent material for irradiating the light to the outside of the coating gap, and

the coating material is prepared with

1. a hardening composition of one-liquid hardening composition having fluidity enabling to fill in the coating gap, and
2. the composition hardening from liquid to solidity by irradiating an ultraviolet ray and/or an electromagnetic ray.
FIG. 1

(a) Longitudinal direction

(b) Diagram of layered structure with labels 10, 12a, 12b, 12S, 20, 11.

(c) Diagram showing layers: Coated layer (20), Polymer layer (12p), Decorative sheet layer (12S), Adhesive layer (13b), Reinforcing layer (12a), Adhesive layer (13b), Resin layer (11).
FIG. 3(a)

FIG. 3(b)
FIG. 5

Plate of the blank material preparing process

Making upper mounted sheet (ex. natural wood, wood-finish sliced sheet)

Making sheet reinforcing plate (ex. veneer plate)

Adhesion (Adhering upper mounted sheet to sheet reinforcing plate)

Making substrate

Adhering upper mounted sheet onto substrate

Coated layer forming process

Substrate of upper mounted specification

Polymer coating

Opening forming die

Setting and closing blank material plate in forming die

Heating forming die

Vacuum pump (Vacuum in coating gap)

Compressor and pouring coating liquid

Irradiation of ultraviolet light

Taking out die

Coating process finish
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C37/00 B29C35/08
ADD.

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)
B29C

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 database and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C

See patent family annex

Date of the actual completion of the international search
9 April 2010

Date of mailing of the international search report
21/04/2010

Name and mailing address of the ISA/
European Patent Office, P B 5818 Patentlaan 2
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Fageot, Philippe

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