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(54) **Process for forming decorative paint film exhibiting metallic effect**

Verfahren zur Herstellung von Lacküberzug mit Metallglanzeffekt

Procédé pour fabriquer des couches de peinture ayant un aspect métallique

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- **PATENT ABSTRACTS OF JAPAN vol. 095, no. 007, 31 August 1995 & JP 07 108216 A (TOYOTA AUTO BODY CO LTD), 25 April 1995**

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Description

Field of the Invention

[0001] The present invention relates to process for forming a decorative paint film in which a decorative layer is formed by drawing, for example, color images on a surface to be painted, such as a surface of an automobile body, and the like. By employing a decorative paint film forming process according to the present invention, it is possible to readily form a vivid decorative paint film which exhibits a metallic effect.

Description of the Related Art

[0002] Recently, so-called ink-jet type printers have been utilized as a printing apparatus for computers. In the ink-jet type printers, four color inks are injected through a nozzle, respectively, in accordance with hues of pixels in the image data which are stored in a memory of a computer. The four color inks are, for instance, red, blue, and yellow (i. e., the three primary colors) inks in addition to a black ink. The four color inks are deposited on a printing paper in dotted fashions, and are superimposed on the printing paper. Thus, the hues of the pixels are reproduced on the printing paper. Then, the nozzles are driven in horizontal directions, and simultaneously the printing paper is driven in vertical directions. As a result, the image data can be drawn on the printing paper.

[0003] The printers are applicable only to paper-like substances to be coated. However, if image data can be drawn, for example, on automobile bodies, complicated decorations can be mass-produced industrially.

[0004] In Japanese Unexamined Patent Publication (KOKAI) No. 1-110,159, Japanese Unexamined Patent Publication (KOKAI) No. 1-128,841, and Japanese Unexamined Patent Publication (KOKAI) No. 1-133,800, there are proposed automatic drawing apparatuses which can enlarge color images to directly print them on wall surfaces, etc. In the automatic drawing apparatuses, 4 nozzle units are driven in 3D directions (e.g., an X-direction, a Y-direction, and a Z-direction). Accordingly, it is possible for the apparatuses to enlarge image data to draw them on wall surfaces to be drawn. Thus, even if decorations are complex, it is possible to mass-produce intricate decorations industrially. As a result, if these apparatuses are applied to form paint films on automobile outer panels, bumper bars, moldings, and the like, the degree of freedom can be improved remarkably in the decorative paint film on these component parts.

[0005] Whilst, metallic coatings are employed widely to paint automobile outer panels. The metallic coatings include aluminum pigments, mica pigments, and so on. In general, the metallic coatings are prepared by the following 2-coat-and-1-bake coating method: namely; a base paint is first applied on a surface of an intermediate paint film. The base paint involves a glossy substance. The term "glossy substance" hereinafter means an aluminum pigment, a mica pigment, etc. Then, a clear paint is applied on a surface of the resulting base paint film by a wet-on-wet coating method, and subsequently the base paint and clear paint are baked and dried to an integral two-layer paint film by heating.

[0006] It is expected to sharply upgrade the decorativeness of the metallic coatings by employing the aforementioned ink-jet method decorative coatings along with the metallic coatings. Japanese Unexamined Patent Publication (KOKAI) No. 7-108,216 discloses such a process. In the process, a decorative coating is carried out on a surface of an intermediate paint film, and thereafter a base paint and a clear paint is applied on the resulting decorative layer entirely.

[0007] According to the process disclosed in Japanese Unexamined Patent Publication (KOKAI) No. 7-108,216, the superficial properties differ between the portions where the decorative layer exists and the portions where no decorative layer exists. Consequently, the orientation of a glossy substance, involved in the base paint film, differs between the portions where the decorative layer exists and the portions where no decorative layer exists. Thus, the process can form a paint film which has an appearance of unique decorativeness.

[0008] In the process disclosed in Japanese Unexamined Patent Publication (KOKAI) No. 7-108,216, however, the surface of the decorative layer is covered with the base paint film. Hence, the process suffers from a drawback in that the vivid hues of the decorative layer are impaired inevitably.

[0009] On the other hand, it is possible to think of mixing a glossy substance in a decorative paint. The ink-jet method, however, employs nozzles which have an aperture of extremely small diameter. Therefore, it is difficult to apply the nozzles to the glossy substances which have usually been used for automobiles, because the glossy substances have considerably large particle diameters. Even if the particle diameters of the glossy substances are reduced to a size which can be injected through the nozzles, the resulting glossy substances exhibit reduced glossiness so that no desirable metallic effects are produced.

SUMMARY OF THE INVENTION

[0010] The present invention has been developed in view of the aforementioned circumstances. It is therefore an object of the present to provide a process for forming a decorative paint film which exhibits vivid hues together with a metallic effect, and which has superb decorativeness.

[0011] A first aspect of the present invention can carry out the aforementioned object, and is a process for forming a decorative paint film exhibiting a metallic effect. The present process comprises:

applying a base paint to form a base paint film having a surface, the base paint including a glossy substance; and
applying a decorative paint with an ink-jet on the surface of the base paint film to form a decorative layer, the decorative layer having a surface and a thickness of less than a hiding thickness.

[0012] Likewise, a second aspect of the present invention can carry out the aforementioned object, and is a process for forming a decorative paint film exhibiting a metallic effect. The present process comprises:

applying a base paint to form a base paint film having a surface, the base paint including a glossy substance;
applying a clear paint on the surface of the base paint film to form a clear coating having a surface; and
applying a decorative paint with an ink-jet on the surface of the clear paint film to form a decorative layer, the decorative layer having a surface and a thickness of less than a hiding thickness.

[0013] Moreover, the present process can be modified as set forth in the following four options:

1) the glossy substance can have an average particle diameter of from 10 to 30 μm;
2) the base paint includes non-volatile compositions, and the non-volatile compositions can include the glossy substance in an amount of from 10 to 50% by weight;
3) the base paint film can exhibit a lightness of 20 or more expressed as an "L" value; and
4) when the decorative layer is laminated on at least one of the base paint film and the clear paint film in a wet manner, a paint film formed of a water based paint, and a paint film formed of an organic solvent based paint can be coated alternately.

The term "hiding thickness" herein and hereinafter means a minimum film thickness which can hide an undercoating so as not to show a color thereof. Moreover, the term "non-volatile compositions" herein and hereinafter means components of a paint, such as resinous solids, pigments, plasticizers, glossy substances, etc., that can substantially constitute a paint film.

[0014] In the first aspect of the present invention, a base paint film is first formed, and subsequently a decorative layer is formed. Before forming the decorative layer, the base paint film can be uncured (i.e., in a wet state), or can be cured to a certain extent by heating it preliminarily. Alternatively, the base paint film can be cared completely. Moreover, a decorative layer can be cured to prepare a decorative paint film. In addition, a clear paint film can preferably be formed on a surface of the decorative layer to prepare a decorative paint film. In this instance, a clear paint can be applied on an uncured decorative layer, and then the resulting clear paint film and the decorative layer can be baked and dried integrally. Alternatively, a decorative layer can be cured, and thereafter a clear paint film can be formed on the cured decorative layer.

[0015] In the thus prepared decorative paint film, the base paint film is visible through the decorative layer, because the decorative layer is formed so as to have a thickness of less than a hiding thickness. Specifically, light transmits through the decorative layer to arrive at the base paint film, and reflects at the glossy substance. The reflected light again transmits through the decorative layer, and finally comes into eyes. As a result, a novel decoration can be produced in which a metallic effect is superimposed on the hues of the decorative layer. When the clear paint film is further formed on the decorative layer, a large refractive index of the clear paint film and an extended optical-path furthermore enhances the metallic effect, and the clear paint film can also protect the decorative layer.

[0016] In the second aspect of the present invention, a base paint film and a clear paint film are formed in advance, and subsequently a decorative layer is formed on the surface of the clear paint film. In the second aspect, after curing the base paint film and clear paint film, the decorative layer can be formed. Alternatively, when the clear paint film is uncured (i.e., in a wet state), a decorative paint can be applied on the uncured clear paint film, and then the resulting decorative layer and the clear paint film can be cured integrally. Moreover, a base paint film, a clear paint film and a decorative layer can be baked and dried integrally by a 3-coat-and-1-bake coating method. In addition, a second or outermost clear paint film can be formed on a surface of the decorative layer.

[0017] In the thus prepared decorative paint film, the base paint film is visible through the clear paint film and the decorative layer, because the decorative layer is formed so as to have a thickness of less than a hiding thickness. Specifically, light transmits through the decorative layer to arrive at the clear paint film, and further transmits through the clear paint film to arrive at the base paint film. Then, the light reflects at the glossy substance. The reflected light again transmits through the clear paint film and decorative layer, and finally comes into eyes. As a result, a novel decoration can be produced in which a metallic effect is superimposed on the hues of the decorative layer. When the second or outermost clear paint film is further formed on the decorative layer, a large refractive index of the second

clear paint film and an extended optical-path furthermore enhances the metallic effect, and the second clear paint film can also protect the decorative layer.

[0018] When a decorative paint is applied on the wet undercoating with respect to the decorative layer: namely; when a decorative paint is applied on the wet base paint film or clear paint film, the decorative paint and the wet undercoating may be mixed with each other. Additionally, when a clear paint is applied on a surface of the wet decorative layer, the clear paint and the wet decorative layer may be mixed with each other. In these instances, there arises a drawback in that the hues of the decorative layer and the contour thereof may become blurry, because the ink-jet method superimposes fine dots to form the decorative layer and to reproduce the hues.

[0019] Hence, the present process can be modified as set forth in the aforementioned fourth option. For instance, when the decorative layer is laminated on at least one of the base paint film and the clear paint film in a wet manner, a paint film formed of a water based paint, and a paint film formed of an organic solvent based paint can preferably be coated alternately. According to the fourth modification, the paints are inhibited from mingling with each other at the interface between the paint films. As a result, it is possible to form a vivid decorative layer which is free from the blur.

[0020] As having described so far, the first and second aspects of the present invention are a process for forming a decorative paint film exhibiting a metallic effect, respectively. The present process can readily produce a decorative paint film which exhibits a unique metallic effect, and which involves a vivid pattern. The unique metallic effect has not been produced by conventional methods so far.

[0021] According to the first through third modifications to the first and second aspect of the present invention, the unique metallic effect, which is exhibited through the decorative layer, can be enhanced furthermore vividly.

[0022] Moreover, according to the fourth modification to the first and second aspect of the present invention, the blurredness is inhibited from occurring. As a result, the hues of the resulting decorative layer, and the profile thereof can be upgraded furthermore vividly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] A more complete appreciation of the present invention and many of its advantages will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings and detailed specification, all of which forms a part of the disclosure:

Fig. 1 is a schematic cross-sectional view of a decorative paint film which was formed by a First Preferred Embodiment according to the present invention; and

Fig. 2 is a schematic cross-sectional view of a decorative paint film which was formed by a Fourth Preferred Embodiment according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Having generally described the present invention, a further understanding can be obtained by reference to the specific preferred embodiments which are provided herein for the purpose of illustration only and not intended to limit the scope of the appended claims.

[0025] In the decorative paint film forming process according to the present invention, conventional base paints can be used as the base paint. For example, the base paint can be a conventional base paint which includes at least a glossy substance selected from the group consisting of an aluminum pigment, a mica pigment, and a pearl mica pigment. The mica pigment can include a silver plating layer formed thereon. The pearl mica pigment can include a titanium oxide layer formed thereon. The base paint can preferably be applied on a substrate so as to form a base paint film having a thickness of from 10 to 30 μm.

[0026] In the base paint, the glossy substance can preferably have an average particle diameter of from 10 to 30 μm. When the glossy substance has an average particle diameter of less than 10 μm, no satisfactory metallic effect can be given to the resulting base paint film. When the glossy substance has an average particle diameter of more than 30 μm, the glossy substance is less likely to parallelly orient in the resulting base film so that no satisfactory metallic effect can be given to the resulting base paint film. In particular, the glossy substance can further preferably have an average particle diameter of from 15 to 20 μm.

[0027] The base paint includes non-volatile compositions, and the non-volatile compositions can preferably contain the glossy substance in an amount of from 10 to 50% by weight. When the non-volatile compositions contain the glossy substance in an amount of less than 10% by weight, no satisfactory metallic effect is given to the resulting base paint film. When the non-volatile compositions contain the glossy substance in an amount of more than 50% by weight, no satisfactory metallic effect is given to the resulting base paint film because the excessively included glossy substance is less likely to parallelly orient in the resulting base paint film. In particular, the non-volatile compositions can further preferably contain the glossy substance in an amount of from 20 to 40% by weight.

[0028] Moreover, the base paint film can preferably exhibit a lightness of 20 or more expressed as an "L" value. When the base paint film exhibits a lightness of less than 20 expressed as an "L" value, no metallic effect is given to the resulting base paint film because the glossy substance, involved in the base paint film, is less likely to be observed through the decorative layer. Note that, when the base paint film exhibits such a low hiding power that the underlying layer can be observed through the base paint film, the "L" value herein means an "L" value of the base paint film through which the underlying layer is visible.

[0029] The decorative paint is not limited to specific paints in particular. For example, the decorative paint can be inks which have been employed by ink-jet methods conventionally. The decorative paint is applied to form a decorative layer having a thickness of less than a hiding thickness. The decorative layer can further preferably have a thickness of 5 μm or less, furthermore preferably from 0.1 to 3 μm. Accordingly, the base paint film, underlying the decorative layer, is visible through the decorative layer. As a result, the resulting decorative paint film exhibits the unique metallic effect. The hiding thickness of the decorative paint depends on a specific pigment included in the decorative paint, and on a concentration of the specific pigment.

[0030] When the specific pigment is a yellow or red pigment, the decorative paint includes non-volatile compositions, and the non-volatile compositions can preferably contain the specific pigment in a concentration of from 30 to 70% by weight, further preferably from 40 to 50% by weight. When the specific pigment is a blue pigment, the decorative paint includes non-volatile compositions, and the non-volatile compositions can preferably contain the specific pigment in a concentration of from 10 to 60% by weight, further preferably from 20 to 30% by weight When the specific pigment is a black pigment, the decorative paint includes non-volatile compositions, and the non-volatile compositions can preferably contain the specific pigment in a concentration of from 5 to 30% by weight, further preferably from 10 to 20% by weight. When the concentration of the specific pigments is more than the upper limits, the resulting decorative paint exhibits a considerably thin hiding thickness so that it is hard to apply the decorative paint to prepare a decorative layer having a thin thickness less than the hiding thickness. When the concentration of the specific pigments is less than the lower limits, and when the resulting decorative paint is applied so as to give a decorative layer desired hues, the resultant decorative layer may occasionally cause running. On the other hand, when the concentration of the specific pigments falls between the upper and lower limits, the decorative paints can be applied to form the decorative layer, which has a thickness of less than a hiding thickness, by applying the decorative paints of the specific colors one after another while controlling the injection amounts of the decorative paints. Note that the thickness of the thus prepared decorative layer is also an optimum thickness which gives the resulting decorative layer desired hues, and which hardly causes the resulting decorative layer to run.

[0031] In addition, in the present decorative paint film forming process, a clear paint can be further applied on the surface of the decorative layer to form a clear paint film. In this instance, the dear paint film can preferably have a thickness of from 20 to 100 μm.

[0032] The present invention will be hereinafter described in detail with reference to preferred embodiments and comparative examples.

First Preferred Embodiment

[0033] A steel plate was subjected to an electrodeposition coating and subsequently to an intermediate coating, thereby preparing a coated plate. Then, an acrylic-melamine organic solvent based paint was applied onto the coated plate in a thickness of about 15 μm. The acrylic-melamine organic solvent based paint exhibited a silver metallic color, and included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 14% by weight, a blue pigment in an amount of 1% by weight, and a black pigment in a trace amount with respect to the whole base paint taken as 100% by weight, respectively.

[0034] The coated plate with the base paint was heated for 5 minutes to preliminarily cure the base paint. Then, a decorative paint film was carried out onto a surface of the resulting base paint film by an ink-jet method with water based inks. Each of the water based inks had a composition as set forth in Table 1 below. The resulting decorative layer involved a flower pattern which was derived from image data. The image data had been produced by scanning a photograph of a flower with an image scanner. The thus formed decorative layer had a thickness of about 1.5 μm at the maximum (i.e., less than the hiding thickness).

TABLE 1

	Yellow Ink	Red Ink	Blue Ink	Black Ink
Concentration of Pigment (PHR)*	50	50	30	15
Resin	Water Soluble Acrylic Resin			
Organic Solvent	14% by Weight			
Water	76% by Weight			

*"PHR" means parts per 100 parts of resin.

[0035] Thereafter, an acrylic-melamine organic solvent based clear paint was applied onto a surface of the thus formed decorative layer, and onto a surface of the base paint film on which the decorative layer was not formed, respectively, in a thickness of about 30 μm. Finally, the coated plate with the clear paint applied was baked and dried at 140 °C for 30 minutes, thereby completing a decorative paint film of a First Preferred Embodiment.

[0036] Fig. 1 illustrates the thus prepared decorative paint film schematically. The decorative paint film comprised an intermediate paint film 1, a base paint film 2, a decorative layer 3, and a clear paint film 4. The base paint film 2 was formed on a surface of the intermediate paint film 1. The decorative layer 3 was partially formed on a surface of the base paint film 2. The clear paint film 4 was formed on a surface of the decorative layer 3, and on a surface of the base paint film 2.

[0037] In the resulting decorative paint film, the decorative layer 3 could be observed through the clear paint film 4. Further, the base paint film 2 could be observed through the decorative layer 3. Furthermore, concerning the portions where the decorative layer 3 was not formed, the base paint film 2 could be observed through the clear paint film 4. Accordingly, the flower pattern, involved in the decorative layer 3, can be observed vividly in the silver metallic color, which was exhibited by the base paint film 2. At the same time, the metallic glossiness, resulting from the aluminum pigment, could be observed in the decorative layer 3. Thus, the decorative paint film was of decorativeness which had not been available so far.

Second Preferred Embodiment

[0038] The base paint was baked and dried at 140 °C for 30 minutes after applying the base paint. Unless otherwise specified, a decorative paint film of a Second Preferred Embodiment was completed in the same manner as the First Preferred Embodiment.

[0039] As a result, a decorative paint film was formed which had the same decorativeness as that of the First Preferred Embodiment.

Third Preferred Embodiment

[0040] The decorative paint film was carried out without preliminary heating the base paint after applying the base paint, and the three layers were baked and dried at 140 °C for 30 minutes in order to integrate the three layers (i.e., the base paint film, the decorative layer and the clear paint film) after applying the clear paint. Unless otherwise specified, a decorative paint film of a Third Preferred Embodiment was completed in the same manner as the First Preferred Embodiment.

[0041] As a result, the thus prepared decorative paint film was of decorativeness which had not been available so far, though it exhibited slight blurredness. The slight blurredness apparently resulted from the decorative layer, which was stained by the base paint and clear paint.

Fourth Preferred Embodiment

[0042] A plate-shaped workpiece was prepared. The workpiece was made from polypropylene, and was coated with

a primer. The primer predominantly contained chlorinated polypropylene. Then, an acrylic-melamine organic solvent based paint was applied onto the plate-shaped workpiece in a thickness of about 15 μm. The acrylic-melamine organic solvent based paint exhibited a red mica metallic color, and included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 2% by weight, a mica pigment in an amount of 6% by weight, and a red pigment in an amount of 20% by weight with respect to the whole base paint taken as 100% by weight, respectively.

[0043] Then, an acrylic-melamine organic solvent based clear paint was applied onto the plate-shaped workpiece with the base paint applied in a thickness of about 30 μm. Subsequently, the workpiece was heated at 120°C for 30 minutes in order to integrally bake and dry the base paint film and clear paint film.

[0044] Thereafter, a geometric pattern was applied onto a surface of the clear paint film by an ink-jet method with water based inks. The water based inks had the same composition as that of the First Preferred Embodiment. The geometric pattern had been produced on a computer monitor. The thus formed decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0045] Finally, an acrylic-melamine organic solvent based clear paint was applied onto a surface of the thus formed decorative layer, and onto a surface of the first (or intermediate) clear paint film on which the decorative layer was not formed, respectively, in a thickness of about 30 μm. The plate-shaped workpiece was subsequently heated at 120 °C for 30 minutes, thereby completing a decorative paint film of a Fourth Preferred Embodiment.

[0046] Fig. 2 illustrates the thus prepared decorative paint film schematically. In the resulting decorative paint film, a decorative layer 3 could be observed through a clear paint film 4. Further, a base paint film 2 could be observed through the decorative layer 3 and an intermediate clear paint film 5. Furthermore, concerning the portions where the decorative layer 3 was not formed, the base paint film 2 could be observed through the clear paint film 4 and intermediate clear paint film 5. Accordingly, the geometric pattern, involved in the decorative layer 3, could be observed vividly in the red mica metallic color, exhibited by the base paint film 2. At the same time, the metallic glossiness, resulting from the aluminum pigment and mica pigment, could be observed in the decorative layer 3. Thus, the decorative paint film was of decorativeness which had not been available so far.

Fifth through Fourteenth Preferred Embodiments

[0047] Except that the pigment concentrations of the inks utilized as a decorative paint were varied as set forth in Table 2 below, a decorative paint film of Fifth through Ninth Preferred Embodiments was prepared in the same manner as the First Preferred Embodiment.

[0048] Likewise, except that the pigment concentrations of the inks utilized as a decorative paint were varied as set forth in Table 2 below, a decorative paint film of Tenth through Fourteenth Preferred Embodiments was prepared in the same manner as the Fourth Preferred Embodiment.

TABLE 2

	Concentration of Pigment (% by Weight)				Observation	Evaluation
	Yellow Ink	Red Ink	Blue Ink	Black Ink		
5th & 10th Pref. Embodiments	30	30	20	10	A decorative paint film of a metallic effect was prepared, but had a light color as a whole.	Good
6th & 11th Pref. Embodiments	40	40	30	20	A decorative paint film of a metallic effect was prepared, but had a slightly light color as a whole.	Good
7th & 12th Pref. Embodiments	50	30	20	20	A decorative paint film of a metallic effect was prepared, but had a slightly intense yellowish color.	Good
8th & 13th Pref. Embodiments	30	50	20	10	A decorative paint film of a metallic effect was prepared, but had a slightly intense reddish color.	Good
9th & 14th Pref. Embodiments	50	50	50	30	A decorative paint film of a metallic effect was prepared, but had a slightly intense bluish color.	Good

It is apparent from Table 2 that decorative paint films of decorativeness which had not been available so far were prepared in the Fifth through Fourteenth Preferred Embodiments. Note that the decorative paint film of the Fifth through Fourteenth Preferred Embodiments had a thickness of less than the hiding thickness even at portions where the multiple

color inks were superimposed.

Fifteenth Preferred Embodiment

[0049] As a base paint, another acrylic-melamine mica metallic base paint was used. The acrylic-melamine mica metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 4.4% by weight, a white mica pigment in an amount of 4.3% by weight, a red pigment in an amount of 0.1% by weight, a yellow pigment in an amount of 0.2% by weight, and a white pigment in an amount of 3.4% by weight with respect to the whole base paint taken as 100% by weight, respectively. The aluminum pigment had an average particle diameter of 15 μm. The white mica pigment had an average particle diameter of 18 μm. Unless otherwise specified, a decorative paint film of a Fifteenth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Fifteenth Preferred Embodiment exhibited a lightness of 55 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0050] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the mica metallic color. Thus, the decorative paint film was of decorativeness which had not been available so far.

Sixteenth Preferred Embodiment

[0051] As a base paint, another acrylic-melamine mica metallic base paint was used. The acrylic-melamine mica metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 1.0% by weight, a red mica pigment in an amount of 3.0% by weight, and a red pigment in an amount of 8.0% by weight with respect to the whole base paint taken as 100% by weight, respectively. The aluminum pigment had an average particle diameter of 11 μm. The red mica pigment had an average particle diameter of 15 μm. Unless otherwise specified, a decorative paint film of a Sixteenth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Sixteenth Preferred Embodiment exhibited a lightness of 25 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0052] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the red mica metallic color. Thus, the decorative paint film was of decorativeness which had not been available so far.

Seventeenth Preferred Embodiment

[0053] As a base paint, another acrylic-melamine metallic base paint was used. The acrylic-melamine metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 19.0% by weight, a blue pigment in an amount of 1.0% by weight, and a black pigment in a trace amount with respect to the whole base paint taken as 100% by weight, respectively. The aluminum pigment had an average particle diameter of 11 μm. Unless otherwise specified, a decorative paint film of a Seventeenth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Seventeenth Preferred Embodiment exhibited a lightness of 74 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0054] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the blue metallic color. Thus, the decorative paint film was of decorativeness which had not been available so far.

Eighteenth Preferred Embodiment

[0055] As a base paint, another acrylic-melamine metallic base paint was used. The acrylic-melamine metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 4.2% by weight, a blue pigment in an amount of 1.0% by weight, and a white pigment in an amount of 4.0% by weight with respect to the whole base paint taken as 100% by weight, respectively. The aluminum pigment had an average particle diameter of 22 μm. Unless otherwise specified, a decorative paint film of an Eighteenth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Eighteenth Preferred Embodiment exhibited a lightness of 68 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0056] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the blue metallic color. Thus, the decorative paint film was of decorativeness which had not been available so far.

Nineteenth Preferred Embodiment

[0057] As a base paint, another acrylic-melamine mica metallic base paint was used. The acrylic-melamine mica metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained a red mica pigment in an amount of 10.0% by weight, and a red pigment in an amount of 9.0% by weight with respect to the whole base paint taken as 100% by weight, respectively. The red mica pigment had an average particle diameter of 15 μm. Unless otherwise specified, a decorative paint film of a Nineteenth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Nineteenth Preferred Embodiment exhibited a lightness of 46 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0058] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the red mica metallic color. Thus, the decorative paint film was of decorativeness which had not been available so far.

Twentieth Preferred Embodiment

[0059] A steel plate was subjected to an electrodeposition coating and subsequently to an intermediate coating, thereby preparing a coated plate. Then, a white color polyester-melamine paint was applied onto the coated plate in a thickness of about 35 μ m, and was baked at 140 °C for 30 minutes. Subsequently, a mica base paint was applied onto a surface of the white color polyester-melamine paint film in a thickness of about 15 μ m. The mica base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained a white mica pigment in an amount of 6.0% by weight with respect to the whole base paint taken as 100% by weight. The white mica pigment had an average particle diameter of 18 μm. Unless otherwise specified, a decorative paint film of a Twentieth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Twentieth Preferred Embodiment, which was formed on the white color polyester-melamine paint film, exhibited a lightness of 79 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0060] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the white mica metallic color. Thus, the decorative paint film was of decorativeness which had not been available so far.

Twenty-first Preferred Embodiment

[0061] As a base paint, another acrylic-melamine metallic base paint was used. The acrylic-melamine metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 3.0% by weight, a red pigment in an amount of 0.1% by weight, a yellow pigment in an amount of 0.2% by weight, and a white pigment in an amount of 3.4% by weight with respect to the whole base paint film taken as 100% by weight, respectively. The aluminum pigment had an average particle diameter of 15 μm. Unless otherwise specified, a decorative paint film of a Twenty-first Preferred Embodiment was prepared in the same manner as the Fist Preferred Embodiment. Note that the base paint film of the Twenty-first Preferred Embodiment exhibited a lightness of 48 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0062] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the metallic color. The decorative paint film was of decorativeness which was not exactly equivalent to that of the Fifteenth through Twentieth Preferred Embodiments, but which had not been available so far.

Twenty-second Preferred Embodiment

[0063] As a base paint, another acrylic-melamine metallic base paint was used. The acrylic-melamine metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 25.0% by weight, a red pigment in an amount of 0.1% by weight, a yellow pigment in an amount of 0.2% by weight, and a white pigment in an amount of 3.4% by weight with respect to the whole base paint taken as 100% by weight, respectively. The aluminum pigment had an average particle diameter of 11 μm. Unless otherwise specified, a decorative paint film of a Twenty-second Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Twenty-second Preferred Embodiment exhibited a lightness of 65 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0064] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the metallic color. The decorative paint film was of decorativeness which was not exactly equivalent to that of the

Fifteenth through Twentieth Preferred Embodiments, but which had not been available so far.

Twenty-third Preferred Embodiment

[0065] As a base paint, another acrylic-melamine metallic base paint was used. The acrylic-melamine metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 20.0% by weight, a red pigment in an amount of 0.1% by weight, a yellow pigment in an amount of 0.2% by weight, and a white pigment in an amount of 3.4% by weight with respect to the whole base paint taken as 100% by weight, respectively. The aluminum pigment had an average particle diameter of 8 μm. Unless otherwise specified, a decorative paint film of a Twenty-third Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Twenty-third Preferred Embodiment exhibited a lightness of 52 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0066] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the metallic color. The decorative paint film was of decorativeness which was not exactly equivalent to that of the Fifteenth through Twentieth Preferred Embodiments, but which had not been available so far.

Twenty-fourth Preferred Embodiment

[0067] As a base paint, another acrylic-melamine mica metallic base paint was used. The acrylic-melamine mica metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained a red mica pigment in an amount of 10.0% by weight, and a red pigment in an amount of 9.0% by weight with respect to the whole base paint taken as 100% by weight, respectively. The red mica pigment had an average particle diameter of 35 μm. Unless otherwise specified, a decorative paint film of a Twenty-fourth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Twenty-third Preferred Embodiment exhibited a lightness of 34 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0068] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the red mica metallic color. The decorative paint film was of decorativeness which was not exactly equivalent to that of the Fifteenth through Twentieth Preferred Embodiments, but which had not been available so far.

Twenty-fifth Preferred Embodiment

[0069] As a base paint, another acrylic-melamine mica metallic base paint was used. The acrylic-melamine mica metallic base paint included 40% by weight of non-volatile compositions. The non-volatile compositions contained a white mica pigment in an amount of 3.0% by weight, a blue mica pigment in an amount of 3.0% by weight, a black pigment in an amount of 2.0% by weight, a green pigment in an amount of 0.2% by weight, and a blue pigment in an amount of 2.0% by weight with respect to the whole base paint taken as 100% by weight, respectively. The white mica pigment had an average particle diameter of 17 μm. The blue mica pigment had an average particle diameter of 17 μm. Unless otherwise specified, a decorative paint film of a Twenty-fifth Preferred Embodiment was prepared in the same manner as the First Preferred Embodiment. Note that the base paint film of the Twenty-fifth Preferred Embodiment exhibited a lightness of 14 expressed as an "L" value, and that the decorative layer had a thickness of about 2 μm at the maximum (i.e., less than the hiding thickness).

[0070] In the thus prepared decorative paint film, the flower pattern exhibiting a unique metallic effect was depicted on the metallic color. The decorative paint film was of decorativeness which was not exactly equivalent to that of the Fifteenth through Twentieth Preferred Embodiments, but which had not been available so far.

[0071] Table 3 below summarizes the content of the glossy substances in the base paints which were employed in the Fifteenth through Twenty-fifth Preferred Embodiments, the average particle diameter of the glossy substances thereof, and the "L" value of the resultant base paint films.

TABLE 3

Identification	Al Pigment Content (% by Weight)	Al Pigment Average Particle Diameter (μm)	Mica Pigment Content (% by Weight)	Mica Pigment Average Particle Diameter (μm)	"L" value, Base Paint Film	Decorativeness
15th Pref. Embodiment	4.4	15	4.3	18	55	Good
16th Pref. Embodiment	1.0	11	3.0	15	25	Good
17th Pref. Embodiment	19.0	11	-	-	74	Good
18th Pref. Embodiment	4.2	22	-	-	68	Good
19th Pref. Embodiment	-	-	10.0	15	46	Good
20th Pref. Embodiment	-	-	6.0	18	79	Good
21st Pref. Embodiment	3.0	15	-	-	48	Good or Fair
22nd Pref. Embodiment	25.0	11	-	-	65	Good or Fair
23rd Pref. Embodiment	20.0	8	-	-	52	Good or Fair
24th Pref. Embodiment	-	-	10.0	35	34	Good or Fair
25th Pref. Embodiment	-	-	6.0	17	14	Good or Fair

[0072] According to the results of the evaluation on the decorative paint films of the Fifteenth through Twenty-fifth Preferred Embodiments, it is believed that the present decorative paint film forming process can preferably be arranged as follows. For instance, a content of a glossy substance can preferably fall in a range of from 10 to 50% by weight, further preferably from 20 to 40% by weight, with respect to non-volatile compositions of a base paint taken as 100% by weight. An average particle diameter of a glossy substance can preferably fall in a range of from 10 to 30 μm, further preferably from 15 to 20 μm. An "L" value exhibited by a base paint film can preferably be 20 or more.

Twenty-sixth Preferred Embodiment

[0073] A plate-shaped workpiece was prepared. The workpiece was made from polypropylene, and was coated with a primer. The primer predominantly contained chlorinated polypropylene. Subsequently, the workpiece was heated preliminarily at 120 °C for 5 minutes. Then, an acrylic-melamine organic solvent based paint was applied onto the workpiece in a thickness of about 15 μm. The acrylic-melamine organic solvent based paint exhibited a silver metallic color, and included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 14% by weight, a blue pigment in an amount of 1% by weight, and a black pigment in a trace amount with respect to the whole base paint taken as 100% by weight, respectively.

[0074] Then, an acrylic-melamine organic solvent based clear paint was applied onto the plate-shaped workpiece with the base paint applied in a thickness of about 30 μm. Subsequently, the base paint and clear paint were baked at 120 °C for 30 minutes.

[0075] Thereafter, a decorative layer was formed onto the plate-shaped workpiece with the base paint film and intermediate clear paint film by an ink-jet method with water based inks. The water based inks included pigments in the same concentrations as set forth in Table 1 above. The resulting decorative layer involved a flower pattern which was derived from image data. Similarly to the First Preferred Embodiment, the image data had been produced by scanning a photograph of a flower with an image scanner. The thus formed decorative layer had a thickness of about 1.5 μm at the maximum (i.e., less than the hiding thickness).

[0076] Finally, an acrylic-melamine organic solvent based clear paint was applied onto the plate-shaped workpiece with the base paint film, intermediate clear paint film and decorative layer coated in a thickness of about 30 μm. The clear paint was subsequently baked at 120 °C for 30 minutes, thereby completing a decorative paint film of a Twenty-sixth Preferred Embodiment.

[0077] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Thus, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Twenty-seventh Preferred Embodiment

[0078] Except that a decorative layer was formed by using organic solvent based inks after the silver metallic base paint and acrylic-melamine clear paint were applied onto the plate-shaped workpiece, and a water based clear paint was finally applied onto the workpiece with the base paint film, intermediate clear paint film and decorative layer to form an outermost clear paint film, a decorative paint film of a Twenty-seventh Preferred Embodiment was completed in the same manner as the Twenty-sixth Preferred Embodiment.

[0079] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Thus, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Twenty-eighth Preferred Embodiment

[0080] A plate-shaped workpiece was prepared. The workpiece was made from polypropylene, and was coated with a primer. The primer predominantly contained chlorinated polypropylene. Subsequently, the workpiece was heated preliminarily at 120 °C for 5 minutes. Then, an acrylic-melamine organic solvent based paint was applied onto the workpiece in a thickness of about 15 μm, and was preliminarily heated at 120 °C for 5 minutes. The acrylic-melamine organic solvent based paint exhibited a silver metallic color, and included 40% by weight of non-volatile compositions. The non-volatile compositions contained an aluminum pigment in an amount of 14% by weight, a blue pigment in an amount of 1% by weight, and a black pigment in a trace amount with respect to the whole base paint taken as 100% by weight, respectively.

[0081] Then, a decorative layer was formed onto the plate-shaped workpiece with the base paint film by an ink-jet method with water based inks. The water based inks included pigments in the same concentrations as set forth in Table 1 above. The resulting decorative layer involved a flower pattern which was derived from image data. Similarly to the First Preferred Embodiment, the image data had been produced by scanning a photograph of a flower with an image scanner. The thus formed decorative layer bad a thickness of about 1.5 μm at the maximum (i.e., less than the hiding thickness).

[0082] Finally, an acrylic-melamine organic solvent based clear paint was applied onto the plate-shaped workpiece with the base paint film and decorative layer in a thickness of about 30 μm. The clear paint film, base paint film and decorative layer were subsequently baked at 120 °C for 30 minutes, thereby completing a decorative paint film of a Twenty-eighth Preferred Embodiment.

[0083] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in

the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Thus, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Twenty-ninth Preferred Embodiment

[0084] Except that a silver metallic base paint film was not dried preliminarily, and a decorative layer was formed by using water based inks immediately after a silver metallic base paint was applied onto the plate-shaped workpiece, a decorative paint film of a Twenty-ninth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0085] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Thus, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirtieth Preferred Embodiment

[0086] Except that a silver metallic base paint film was formed by using a water based paint, a decorative layer was formed by using organic solvent based inks, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Thirtieth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0087] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Thus, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-first Preferred Embodiment

[0088] Except that a silver metallic base paint film was formed by using water based paint, a silver metallic base paint film was not dried preliminarily, a decorative layer was formed by using organic solvent based inks immediately after a silver metallic base paint was applied onto the plate-shaped workpiece, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Thirty-first Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0089] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Thus, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-second Preferred Embodiment

[0090] Except that a decorative layer was formed by using organic solvent based inks, and a clear paint film was formed by using an organic solvent based clear paint, a decorative paint film of a Thirty-second Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0091] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Thirty-second Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-third Preferred Embodiment

[0092] Except that a decorative layer was formed by using water based inks, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Thirty-third Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0093] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Thirty-third Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-fourth Preferred Embodiment

[0094] Except that a silver metallic paint film was formed by using an organic solvent based paint, a decorative layer was formed by using organic solvent based inks, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Thirty-fourth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0095] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as welt Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Thirty-fourth Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-fifth Preferred Embodiment

[0096] Except that a silver metallic paint film was formed by using an organic solvent based paint, a decorative layer was formed by using water based inks, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Thirty-fifth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0097] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Thirty-fifth Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-sixth Preferred Embodiment

[0098] Except that a silver metallic paint film was formed by using a water based paint, a decorative layer was formed by using water based inks, and a clear paint film was formed by using an organic solvent based clear paint, a decorative paint film of a Thirty-sixth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0099] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Thirty-sixth Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-seventh Preferred Embodiment

[0100] Except that a silver metallic base paint film was formed by using an organic solvent based paint, a silver metallic base paint film was not dried, a decorative layer was formed by using organic solvent based inks immediately after a silver metallic base paint was applied onto the plate-shaped workpiece, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Thirty-seventh Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0101] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Thirty-seventh Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-eighth Preferred Embodiment

[0102] Except that a silver metallic base paint film was formed by using an organic solvent based paint, a silver metallic base paint film was not dried, a decorative layer was formed by using water based inks immediately after a silver metallic base paint was applied onto the plate-shaped workpiece, and a clear paint film was-formed by using a water based clear paint, a decorative paint film of a Thirty-eighth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0103] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic

effect of the flower pattern, involved in the decorative paint film of the Thirty-eighth Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Thirty-ninth Preferred Embodiment

[0104] Except that a silver metallic base paint film was formed by using a water based paint, a silver metallic base paint film was not dried, a decorative layer was formed by using water based inks immediately after a silver metallic base paint was applied onto the plate-shaped workpiece, and a clear paint film was formed by using an organic solvent based clear paint, a decorative paint film of a Thirty-ninth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0105] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Thirty-ninth Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Fortieth Preferred Embodiment

[0106] Except that a silver metallic paint film was formed by using an organic solvent based paint, a decorative paint film was formed by using organic solvent based inks, and a clear paint film was formed by using an organic solvent based clear paint, a decorative paint film of a Fortieth Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0107] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Fortieth Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Forty-first Preferred Embodiment

[0108] Except that a silver metallic paint film was formed by using an organic solvent based paint, a silver metallic base paint film was not dried, a decorative layer was formed by using organic solvent based inks immediately after a silver metallic base paint was applied onto the plate-shaped workpiece, and a clear paint film was formed by using an organic solvent based clear paint, a decorative paint film of a Forty-first Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0109] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Forty-first Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Forty-second Preferred Embodiment

[0110] Except that a silver metallic paint film was formed by using a water based paint, a decorative layer was formed by using water based inks, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Forty-second Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0111] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Forty-second Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

Forty-third Preferred Embodiment

[0112] Except that a silver metallic paint film was formed by using a water based paint, a silver metallic base paint film was not dried, a decorative layer was formed by using water based inks immediately after a silver metallic base

paint was applied onto the plate-shaped workpiece, and a clear paint film was formed by using a water based clear paint, a decorative paint film of a Forty-third Preferred Embodiment was completed in the same manner as the Twenty-eighth Preferred Embodiment.

[0113] As a result, the thus prepared decorative paint film involved the flower pattern which was depicted vividly in the silver metallic color. The flower pattern exhibited a unique metallic effect as well. Although the vividness and metallic effect of the flower pattern, involved in the decorative paint film of the Forty-third Preferred Embodiment, were not precisely correspondent with those of the Twenty-eighth through Thirty-first Preferred Embodiment, the decorative paint film was of decorativeness which had not been produced by conventional coating processes so far.

[0114] Having now fully described the present invention, it will be apparent to one of ordinary skill in the art that many changes and modifications can be made thereto without departing from the spirit or scope of the present invention as set forth herein including the appended claims.

[0115] A decorative paint film forming process includes the steps of applying a base paint, including a glossy substance, to form a base paint film, and applying a decorative paint on a surface of the base paint film to form a decorative layer having a thickness of less than a hiding thickness. Alternatively, a clear paint can be applied on the base paint film to form a clear paint film, and the decorative layer can be formed on the clear paint film. The resulting decorative paint film involves a noble decoration in which a metallic effect is superimposed on the hues of the decorative layer.

Claims

1. A process for forming a decorative paint film exhibiting a metallic effect, the process comprising the steps of:

   applying a base paint to form a base paint film having a surface, the base paint including a glossy substance; and
   applying a decorative paint with an ink-jet on the surface of the base paint film to form a decorative layer, the decorative layer having a surface and a thickness of less than a hiding thickness.

2. The process according to Claim 1, wherein the glossy substance has an average particle diameter of from 10 to 30 μm.

3. The process according to claim 1, wherein the base paint includes non-volatile compositions and the non-volatile compositions contain the glossy substance in an amount of from 10 to 50% by weight.

4. The process according to Claim 1, wherein the base paint film exhibits a lightness of 20 or more expressed as an "L" value.

5. The process according to Claim 1, wherein, when the decorative layer is laminated on the base paint film in a wet manner, a paint film formed of a water based paint, and a paint film formed of an organic solvent based paint are coated alternately.

6. The process according to claim 1, wherein the decorative paint includes non-volatile compositions, and the non-volatile compositions contain a yellow pigment in an amount of from 30 to 70% by weight.

7. The process according to claim 1, wherein the decorative paint includes non-volatile compositions, and the non-volatile compositions contain a red pigment in an amount of from 30 to 70% per weight.

8. The process according to Claim 1, wherein the decorative paint includes non-volatile compositions, and the non-volatile compositions contain a blue pigment in an amount of from 10 to 60% by weight.

9. The process according to Claim 1, wherein the decorative paint includes non-volatile compositions, and the non-volatile compositions contain a black pigment in an amount of from 5 to 30% by weight.

10. The process according to Claim 1, wherein the base paint film has a thickness of from 10 to 30 μm.

11. The process according to Claim 1, wherein the decorative layer has a thickness of 5 μm or less.

12. The process according to Claim 1 further comprising a step of applying a clear paint on the surface of the decorative layer to form a clear paint film.

13. The process according to Claim 12, wherein the clear paint film has a thickness of from 20 to 100 μm.

14. The process according to Claim 12, wherein the decorative paint is heated preliminarily before applying the clear paint

15. The process according to Claim 12, wherein the decorative paint is baked before applying the clear paint paint.

16. The process according to Claim 1, wherein the base paint is heated preliminarily before applying the decorative paint.

17. The process according to Claim 1, wherein the base paint is baked before applying the decorative paint.

18. A process for forming a decorative paint film exhibiting a metallic effect, the process comprising the steps of:

applying a base paint to form a base paint film having a surface, the base paint including a glossy substance;
applying a clear paint on the surface of the base paint film to form a clear paint film having a surface; and
applying a decorative paint on the surface of the clear paint film to form a decorative layer, the decorative layer having a surface and a thickness of less than a hiding thickness.

Patentansprüche

1. Verfahren zur Herstellung eines dekorativen Lacküberzugs, der einen Metallglanzeffekt zeigt, wobei das Verfahren die nachstehenden Schritte umfasst:

Aufbringen eines Grundlacks, um einen Grundlacküberzug mit einer Oberfläche zu bilden, wobei der Grundlack eine glänzende Substanz einschließt; und

Aufbringen einer Dekorationsfarbe mit einem Tintenstrahl auf die Oberflache des Grundlacküberzugs, um eine Dekorationsschicht zu bilden, wobei die Dekorationsschicht eine Oberfläche und eine Dicke aufweist, die kleiner als die Deckdicke ist.

2. Verfahren nach Anspruch 1, wobei die glänzende Substanz einen mittleren Teilchendurchmesser von 10 bis 30 μm aufweist.

3. Verfahren nach Anspruch 1, wobei der Grundlack nichtflüchtige Zusammensetzungen einschließt and die nichtflüchtigen Zusammensetzungen die glänzende Substanz in einer Menge von 10 bis 50 Gew.-% enthalten.

4. Verfahren nach Anspruch 1, wobei der Grundlacküberzug eine Helligkeit von 20 oder größer, ausgedrückt als "L"-Wert, zeigt.

5. Verfahren nach Anspruch 1, wobei, wenn die Dekorationsschicht auf den Grundlacküberzug auf nasse Weise laminiert wird, eine aus einer Farbe auf Wasserbasis gebildete Farbschicht und ein aus einem Lack auf Basis eines organischen Lösungsmittel gebildeter Lacküberzug abwechselnd aufgebracht werden.

6. Verfahren nach Anspruch 1, wobei die Dekorationsfarbe nichtflüchtige Zusammensetzungen einschließt, und die nichtflüchtigen Zusammensetzungen ein gelbes Pigment in einer Menge von 30 bis 70 Gew.-% enthalten.

7. Verfahren nach Anspruch 1, wobei die Dekorationsfarbe nichtflüchtige Zusammensetzungen einschließt, und die nichtflüchtigen Zusammensetzungen ein rotes Pigment in einer Menge von 30 bis 70 Gew.-% enthalten.

8. Verfahren nach Anspruch 1, wobei die Dekorationsfarbe nichtflüchtige Zusammensetzungen einschließt, und die nichtflüchtigen Zusammensetzungen ein blaues Pigment in einer Menge von 10 bis 60 Gew.-% enthalten.

9. Verfahren nach Anspruch 1, wobei die Dekorationsfarbe nichtflüchtige Zusammensetzungen einschließt, und die nichtflüchtigen Zusammensetzungen ein schwarzes Pigment in einer Menge von 5 bis 30 Gew.-% enthalten.

10. Verfahren nach Anspruch 1, wobei der Grundlacküberzug eine Dicke von 10 bis 30 μm aufweist.

11. Verfahren nach Anspruch 1, wobei die Dekorationsschicht eine Dicke von 5 μm oder weniger aufweist.

12. Verfahren nach Anspruch 1, das des weiteren einen Schritt des Aufbringens eines Klarlacks auf die Oberfläche der Dekorationsschicht, um einen Klarlacküberzug zu bilden, umfasst .

13. Verfahren nach Anspruch 12, wobei der Klarlacküberzug eine Dicke von 20 bis 100 μm aufweist.

14. Verfahren nach Anspruch 12, wobei die Dekorationsfarbe vorausgehend erwärmt wird, bevor der Klarlack aufgebracht wird.

15. Verfahren nach Anspruch 12, wobei die Dekorationsfarbe gehärtet wird, bevor der Klarlack aufgebracht wird.

16. Verfahren nach Anspruch 1, wobei der Grundlack vorausgehend erwärmt wird, bevor die Dekorationsfarbe aufgebracht wird.

17. Verfahren nach Anspruch 1, wobei der Grundlack gehärtet wird, bevor die Dekorationsfarbe aufgebracht wird.

18. Verfahren zur Herstellung eines dekorativen Lacküberzugs, der einen Metallglanzeffekt zeigt, wobei das Verfahren die nachstehenden Schritte umfasst:

Aufbringen eines Grundlacks, um einen Grundlacküberzug mit einer Oberflache zu bilden, wobei der Grundlack eine glänzende Substanz einschließt;

Aufbringen eines Klarlacks auf die Oberfläche des Grundlacküberzugs, um einen Klarlacküberzug mit einer Oberfläche zu bilden; und

Aufbringen einer Dekorationsfarbe auf die Oberfläche des Klarlacküberzugs, um eine Dekorationsschicht zu bilden, wobei die Dekorationsschicht eine Oberfläche und eine Dicke aufweist, die kleiner als die Deckdicke ist.

Revendications

1. Procédé de formation d'un film de peinture décorative présentant un effet métallique, le procédé comprenant les étapes :

D'application d'une peinture de base pour former un film de peinturc de base ayant une surface, ladite peinture de base comportant une substance brillante ; et

D'application d'une peinture décorative au moyen d'un jet d'encre sur la surface du film de peinture de base pour former une couche décorative ayant une surface et une épaisseur plus faible qu'une épaisseur couvrante.

2. Procédé selon la revendication 1, dans lequel la substance brillante possède des particules de diamètre moyen entre 10 et 30 μm.

3. Procédé selon la revendication 1, dans lequel la peinture de base comprend des compositions non-volatiles et lesdites compositions non-volatiles contiennent la substance brillante en proportion variant de 10 à 50% en masse.

4. Procédé selon la revendication 1, dans lequel le film de peinture de base présente une clarté de 20 ou plus exprimée en valeur « L ».

5. Procédé selon la revendication 1, dans lequel, lorsque la couche décorative est appliquée en strates sur le film de peinture de base selon un procédé humide, un film de peinture formé d'une peinture à base d'eau et un film de peinture formé d'une peinture à base de solvant organique sont enduits alternativement.

6. Procédé selon la revendication 1, dans lequel la peinture décorative comprend des compositions non-volatiles et lesdites compositions non-volatiles contiennent un pigment jaune en proportion variant de 30 à 70 % en masse.

7. Procédé selon la revendication 1, dans lequel la peinture décorative comprend des compositions non-volatiles et

lesdites compositions non-volatiles contiennent un pigment rouge en proportion variant de 30 à 70 % en masse.

8. Procédé selon la revendication 1, dans lequel la peinture décorative comprend des compositions non-volatiles et lesdites compositions non-volatiles contiennent un pigment bleu en proportion variant de 10 à 60 % en masse.

9. Procédé selon la revendication 1, dans lequel la peinture décorative comprend des compositions non-volatiles et lesdites compositions non-volatiles contiennent un pigment noir en proportion variant de 5 à 30 % en masse.

10. Procédé selon la revendication 1, dans lequel le film de peinture de base possède une épaisseur entre 10 et 30 µm.

11. Procédé selon la revendication 1, dans lequel la couche décorative possède une épaisseur de 5 µm ou moins.

12. Procédé selon la revendication 1, comprenant en outre une étape d'application d'une peinture claire sur la surface de la couche décorative pour former un film de peinture claire.

13. Procédé selon la revendication 12, dans lequel le film de peinture claire a une épaisseur ente 20 et 100 µm.

14. Procédé selon la revendication 12, dans lequel la peinture décorative est chauffée préalablement à l'application de la peinture claire.

15. Procédé selon la revendication 12, dans lequel la peinture décorative est cuite avant l'application de la peinture claire.

16. Procédé selon la revendication 12, dans lequel la peinture de base est chauffée préalablement à l'application de la peinture décorative.

17. Procédé selon la revendication 12, dans lequel la peinture de base est cuite avant l'application de la peinture décorative.

18. Procédé afin de former un film de peinture décorative présentant un effet métallique, le procédé comprenant les étapes :

D'application d'une peinture de base pour former un film de peinture de base ayant une surface, ladite peinture de base comportant une substance brillante ;

D'application d'une peinture claire sur la surface du film de peinture de base pour former un film de peinture claire ayant une surface ; et

D'application d'une peinture décorative sur la surface du film de peinture claire pour former une couche décorative ayant une surface et une épaisseur plus faible qu'une épaisseur couvrante.

FIG. 1

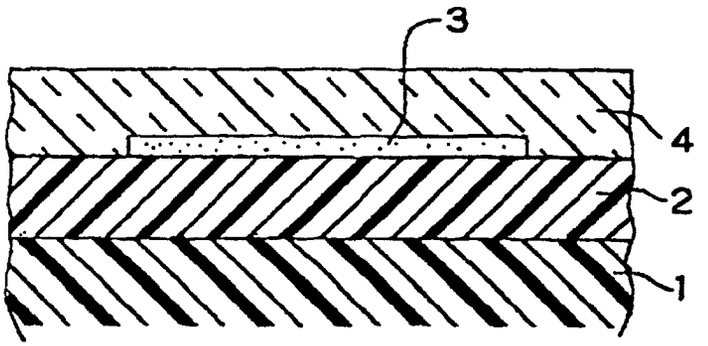

FIG. 2