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(54) **Process for the production of structural and/or decorative plastered elements, and plastered elements so obtained**

(57) A process for the realization of structural and/or decorative elements for the building field, internal fittings, town-fittings, such as panels, partitions, door and window frames, false ceilings and the like, having one- or multi-color decorations, said process consisting in the transfer and incorporation in a plaster layer coated on a backing from rigid or semi-rigid material of a sublimable color decoration, employing the transfer decoration

technique.

A variously decorated structural and/or decorative element for the building field, fittings and the like, such as panels, partitions, false ceilings and the like, comprising a backing in the form of a slab, a section or the like, comprising a hardened plaster layer coated on the surface of said backing or a part of said surface, and a one- or multi-color decoration realized on said plaster layer by means of sublimable colors.

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Description

[0001] The present invention relates to a process for the production of variously decorated plastered structural and/or decorative elements, in particular for the building field, such as covering panels, false ceilings, partitions and the like, with excellent characteristics of stability to light and weathering and polluting agents, as well as of mechanical strength.

[0002] The present invention also relates to the so obtained structural and decorative plastered elements.

[0003] The decoration or painting of mortar plasters, utilized especially in the building field, is usually carried out according to known decoration and coloring techniques, such as brush or spray or roll varnishing or painting directly coated on walls.

[0004] On panels having also complex size and sections composed of concrete or mortars obtained as coatings on any materials, the decoration and painting techniques range from silk-screen techniques, known also in ceramics, to the more recent painting techniques making use of photomechanical processes or the like.

[0005] The characteristic shared by these techniques is that of allowing the decoration and the painting on the surface of the mortar plaster by operating directly on the surface of the same once the artifact has been obtained either in the form of a wall or a panel covering.

[0006] The paints adhere to the surface of the plaster, restraining all the process and resistance limits to the environment conditions, well known to everybody as deteriorating even art masterpieces.

[0007] Object of the present invention is to realize a process for the production of plastered and decorated panels, partitions, door and window frames, false ceilings and the like, to be used as structural and decorative elements in the building field, for internal fittings, town-fittings, and the like.

[0008] Another object of the invention is to realize a process for the production of plastered panels and the like for the building field and fittings in general, said panels bearing a decoration resistant to weathering and light as well as to mechanical stresses, such as bending, impacts, etc.

[0009] A further object is to provide plastered structural elements for the building field and fittings bearing multi-color decorations and also "antique-imitation" decorations, i.e. decorations that imitate and/or reproduce paintings realized in ancient times, as they appear at present.

[0010] These and still other objects and related advantages that will be apparent from the following description are achieved by a process for the realization of structural and/or decorating elements for the building field, internal fittings, town-fittings, such as panels, partitions, door and window frames, false ceilings and the like, bearing one- or multi-color decorations, which process, according to the present invention, consists in the transfer and incorporation in a plaster layer coated on a

backing from rigid or semi-rigid material a sublimable color decoration employing the transfer decoration technique.

[0011] As is known, the transfer decoration technique consists in the transfer of a decoration realized with sublimable colors on a flexible backing such as paper, fabric, plastics or the like, from said backing to the article to be decorated by means of the combined action of pressure and temperature applied to the flexible backing, which is caused to adhere to the article by suitable means, as described for instance in the European Patent no. 0817728 owned by the same applicant, as well as by FR 2203321, EP 544603, etc.

[0012] More particularly, said process comprises the following steps:

- submitting said backing from rigid or semi-rigid material to one or more degreasing, cleaning, surface conversion treatments, and anti-corrosion treatments in the case of metals, and anodizing in case of aluminum and alloys thereof;
- submitting said so treated backing to one or more operations of pre-painting with colored paints, either opaque or transparent, suitable to form a primer base or layer;
- transferring on said treated and pre-painted backing a preparatory decoration with sublimable colors from a suitable flexible backing, by means of the transfer technique;
- coating said sublimable color decoration transferred on said backing with a plaster mortar layer;
- submitting to drying and heating said backing comprising said decoration and said layer of plaster mortar, according to a pre-fixed program, with ensuing hardening of said plaster and diffusion, surfacing and curing of said decoration on the surface of said hardened plaster.

[0013] The material which said rigid or semi-rigid backing is made from is selected from among ferrous metals, non-ferrous metals and light alloys, marble, stone, ceramics, bricks, cement type materials, glass, wood plates, and wood derivatives, special plastic materials and composites.

[0014] Said backing from rigid or semi-rigid material may be in the form of sheets, slabs, tubes, tapes, sections or the like, and may have a size of up to 8000x2000 mm. In general, any material may be used, provided it is resistant to temperatures of up to 250°C, i.e. the temperatures at which the sublimable color transfer operations are carried out.

[0015] The sublimation transfer of the preparatory decoration to the surface of the rigid backing may be carried out by means of processes and apparatuses such as: a press with a flat compressing element, a calender, a two-frame press with flexible and impermeable membranes, plus vacuum utilization, a sucking rigid platen with a flexible and impermeable membrane, plus

vacuum utilization, a sucking platen or impermeable plastic films bearing the decoration to be transferred, utilized in combination with vacuum and without contact elastic membranes. Said films are of the heat-formable type and of the heat-retractable type. These films are available in the form of tubes, tapes and sheets. Besides, also silicone rubber tubes may be utilized wherein the backings to be decorated may be inserted wrapped up in papers, yielding fabrics bearing the preparatory pattern to be transferred, also in this case in combination with vacuum.

[0016] The conditions of the transfer process for the preparatory decoration may be the following:

- a temperature from 150°C to 230°C,
- a time from 30 sec. to 30',
- a pressure from 0,1 Ate to 7 Ate.

[0017] Plaster is a plastic mixture of various inorganic and organic ingredients and binders with water, that hardens upon drying and heating and the various chemical reactions that occur between the various ingredients and binders, creating a cured and hardened layer.

[0018] The plaster according to the invention may be coated on the backing by roll, brush, knife, trowel, spray or other coating means.

[0019] The thickness may be obtained by one or more layers, and the same may range from 0,5 mm to about 5 mm.

[0020] Once the plaster has been coated on the backing and dried at room temperature and moisture for a time ranging from 1 hour to 24 hours, the same is introduced in a hot and dry air oven, finally hardened and dried at a temperature comprised between 60°C and 250°C for a time comprised between 1' and 30'.

[0021] By such treatment, the previously printed preparatory decoration spreads through the thickness of the plaster, which has a porosity and a permeability suitable for the purpose. It must allow, in fact, the diffusion of the pigments through its thickness up to the surface. Besides, the plaster according to the invention is also very resistant to the formation of fractures, thermal shocks and the bending of the backing up to very low angles of less than some millimeters.

[0022] According to an alternative embodiment of the invention, said step of submitting to drying and heating said backing comprising said decoration and said plaster layer is carried out under pressure.

[0023] Pressure is applied either by compressing means such as internally heated rolls or pads that are pressed against the surface of the plaster during the heating step, or, when the size and shape of the structural elements allow it, by introducing said element in heated pressurized containers, such as autoclaves or the like.

[0024] Generally, the pressure applied is comprised in the range between 0,1 Ate and 7 Ate.

[0025] Surprisingly, it has been found, in fact, that by

carrying out the drying and heating step under pressure, the curing times of plaster and stabilization of the decoration on the surface of the plaster markedly reduce, up to 20%, with ensuing additional advantages of productivity and reduction in process costs.

[0026] The flow of a sublimation-generated gas that transports the pigments from the preparatory pattern to the backing surface through the solid porous means, such as a plaster mortar, is caused, according to the present invention, by the continuity and motion equations already known and typical of the processes that describe the passage of a fluid, a liquid or a gas, through a solid porous means, such as plaster mortar.

[0027] The main parameters that must be controlled in the present invention may be grouped into two main groups:

- a) parameters of the materials: pigments and plaster mortar;
- b) process parameters: temperature and pressure and thickness of the plaster.

a) The parameters of the pigment material include: viscosity of their gas at sublimation temperature; specific weight (or density) at sublimation temperature; the parameters of the plaster mortar material include: porosity (or the actual surface gone through in their inside, which is given by the void and solid ratio) which is at the origin of the permeability of the sublimation gas that goes through it at a given temperature and pressure.

b) The process parameters include: the temperature associated to the sublimation transition of the various pigments, the pressure necessary to originate and complete the sublimation gas flow through the plaster mortar thickness and the thickness of the plaster mortar that is supposed to be very constant. The plaster surface is a parameter that is fixed by the size of the equipment, but does not fall directly within the parameters of the process control. In fact, once the dimensional characteristics of the artifact to be realized according to the present invention have been fixed, said characteristics are no longer subject to control.

[0028] After several theoretical-experimental verifications to verify the continuity and motion equations as state equations that control the process of the present invention, it is possible to synthesize that in practice the basic relations are the following ones:

1) The basic equation of the motions of a gas through a porous material is reducible to Darcy's formula:

$$V = f [\Delta P / (P_s \cdot d)] \quad (1)$$

wherein:

V = infiltration speed (m/s) referred to the gross section (full by void) gone through by the sublimation gas in the plaster layer;

ΔP = pressure jump (kg/m^2) through the thickness of the entire section;

P_s = specific weight (kg/m^3) of the gas going through;

d = thickness (m) of the material gone through;

f = permeability of the material gone through (m/s) which is obviously bound to the porosity of the mortar and also to the viscosity of the gas. By way of example, to have some numerical references, the f value ranges from $2 \cdot 10^{-5}$ m/sec for thin sand having bead diameters of 0,1-0,2 mm to 1×10^{-2} of sand containing fine gravel having bead diameters of 1-3 mm.

[0029] Relation (1) may be expressed in practical terms also as:

$$W = P_s \cdot V = f (\Delta P / d) \quad (2)$$

wherein:

$W = P_s \cdot V$ = capacity in weight [$\text{kg}/(\text{m}^2 \cdot \text{sec})$] per mortar surface gone through.

[0030] The experiments carried out on the present invention have allowed to verify that the permeability of plaster mortar for a thickness from 0,2 to 5 mm is the mean of f value = $1,29 \cdot 10^{-7}$ $\text{kg}/(\text{m}^2 \cdot \text{sec})$ at least with room temperature air (20°C) and pressures from 0,1 Ate to 7 Ate.

[0031] The experiments carried out with the same plaster thicknesses of 0,1-5 mm, the same pressures and temperatures in the range $175-250^\circ\text{C}$, have allowed to find, instead, that the permeability of plaster mortar reached for the sublimation gas of pigments a mean $f = 1, 6, 10^{-4}$ $\text{kg}/(\text{m}^2 \cdot \text{sec})$.

[0032] In other words, with respect to Darcy's law (1) it may be said that the ablative gas of transfer pigments goes through plaster mortar with a permeability higher by about 3 orders of magnitude.

[0033] In order to establish the concept, in the aforementioned conditions, the mortar thickness of 0,2 mm is gone through by 5 g of ablative gas in 30 sec. per m^2 surface at the temperature of 180°C and for a pressure difference of 0,7 kg/cm^2 .

[0034] This observation leads to specific considerations on the innovating nature of the present invention because of the following reasons:

1. the permeability is rather high because of the high temperature at which it takes place;
2. the flow of ablative gases goes through the selected plaster thickness until it surfaces, and a large part of the same is absorbed on the internal surfaces of the pores.

[0035] This may be attributed to the presence in the plaster of polymers (2% by weight) and carbon fibers (0,3-0,5%). Carbon fibers, in particular, contribute with their presence both to the porosity of the plaster between their links and to the increase in porosity, given their intrinsically porous structure.

[0036] The inorganic material of the plaster has also a function of activation of the absorption of the ablative gas such as to facilitate the transfer of dyes.

[0037] All these characteristics are at the base of the innovating concepts of the present invention, and therefore the ablative pigments transferred to the backing of a plaster operates as a pre-constituted deposit, like one on a paper, to transfer on the polymerized surface (painted) of the pores of the same plaster mortar, causing therefore the surfacing of the prefabricated patterns on its external surface.

[0038] In particular, it may be inferred from formula (2) that, temperature being constant, the flow of ablative gases linearly depend on pressure, inversely proportionally on the thickness of plaster, but especially on its permeability that depends on the material and especially its porosity and the specific weight of the ablative gas; permeability is a property of the material, the specific weight is a property of the ablative gas that, in its turn, depends on the process temperature.

[0039] The plaster mortar according to the present invention has convenient porosity values ϵ through its thickness, and therefore a given permeability f of the gas coming from the paint system of the preparatory patterns on the backing surface. Such ablative gas at a given temperature has a determined specific weight and succeeds in going through mortar porosity by means of an extraction flow caused by the pressure difference Δp applied on the plaster surface of the wall facing the room.

[0040] Such flow of ablative air allows to realize the painting on the plaster surface.

[0041] The one or multi-color decoration is realized on the plaster layer according to the invention after having gone through the thickness of said plaster.

[0042] The decoration takes place because of the surfacing on the plaster of colors coming by sublimation from pigments transfer-deposited on the plaster backing surface and going through the thickness of plaster in the form of a gas due to sublimation of the same.

[0043] Temperature T and pressure P are two variables that depend on the process and that determine the time necessary and therefore the efficiency of the process.

[0044] Preferably, according to the present invention, said plaster has a permeability f comprised between 10^{-4} and 10^{-7} $\text{kg}/(\text{m}^2 \cdot \text{sec})$.

[0045] The intrinsic properties of the plaster mortar according to the present invention must take into account three types of characteristics:

- a) porosity inter-communicating in the entire vol-

ume and suitable as much as possible to have an intrinsic permeability k necessary to cause the ablative gas coming from the paints of pigments of the preparatory pattern on the surface of the plaster backing layer to pass easily. The temperature of the gas flow process T and room temperature Δp are the process parameters according to formulae (1) and (2), and have been confirmed by the experiments carried out;

b) resistance to fracturing for environment reasons due to thermal or vibration shocks with various levels of humidity and possible deterioration. Because of the mechanical characteristics of standard mortar plasters, new types of mortars have been experimented, mixed with special fiber reinforcements (composite technology) and with plasticizers from plastics that render mortar less mechanically rigid; c) mortar must be easy to spray on the backing coating, in spite of its containing reinforcing elements. from fibers, or anyhow they must have a workability possible with the standard coating and spreading technologies, as that of the usually employed plasters. The thickness of mortar must be very constant and comprised between 0,2 and 5 mm, with tolerances lower than 2%.

[0046] After several experiments with various mortars, at present the plaster mortar called "Mighty CF" has proved particularly advantageous; said mortar is produced by the MIGHTY KAGAKU Company, a Division of MIGHTY CHEMICAL CO, with headquarters in Japan an has the following composition:

- a composite having as a main component a mixture of finely divided silica white cement and carbon fibers; the white cement mainly contains calcium oxide, silica and alumina; silanol groups between the finely divided silica promote the dispersion, the adhesion on the backing materials and the resistance to corrosion;
- a water-soluble hardening material containing a mixture of cationic acrylic resin, an anionic acrylic resin and an anti-coagulant agent as nonionic surfactant to prevent gelling;
- optionally, an actiphenoxypolyethoxy alcohol and a fluorinated resin.

[0047] The above plaster mortar had demonstrated sufficient a, b, c properties and a porosity such as to impart the ablative gas a permeability f that has given good experimental results as a function of the specific weight of the ablative gas at given temperatures T and pressures Δp of the experimented process.

[0048] Fracturing resistance and cracking resistance are high thanks to the presence of carbon fibers and confirmed by the fact that no fracturing or cracking appear on flexible backing panels, such as aluminum and steel panels, even by 180° radius bending.

[0049] Resistance to weathering, UV and humidity with oxidation is similar to that of standard plaster mortars.

[0050] The process according to the present invention is realized also by utilizing different types of mortar, provided they satisfy the above indicated characteristics.

[0051] According to a variant of the present invention, the process comprises the following steps:

- possibly submitting said backing from rigid or semi-rigid material to one or more degreasing, cleaning, possible surface conversion treatments, and anti-corrosion treatments in the case of metals, possible anodizing in case of aluminum and alloys thereof;
- coating said backing with a plaster mortar layer;
- submitting to drying and heating said backing comprising said plaster mortar layer until said plaster has hardened;
- transferring on the hardened plaster present on said backing a sublimable color decoration from a suitable flexible backing, by means of the transfer technique.

[0052] This variant of the invention allows to simplify to some extent the process; according to such variant, the diffusion of the pigments that form the decoration occurs from the outside towards the inside of the plaster layer, instead of from the inside towards the outside as described above.

[0053] Actuation example.

[0054] Having selected a backing, for instance from aluminum, a transfer preparatory pattern was deposited, taking care to leave it incomplete in order to allow a subsequent ablation once the aforementioned mortar composition has been coated. Such incomplete ablation is a variant of the process.

[0055] Also the thickness of the plaster mortar is a variable of the process, and thicknesses have been selected in the range from 0,2 to 0,5 mm.

[0056] The plaster coating was realized by means of a spraying device particularly suitable to obtain thickness uniformity and surface compactness.

[0057] After this operation, the panel is left in an oven, wherein the optimum temperature and pressure conditions are created. See formula (2) for the transfer of the preparatory pattern to the plaster surface through its thickness that after some time appears even in intense colors.

[0058] According to the process subject matter of the present invention, a variously decorated structural and/or decorative element is obtained for use in the building field, fittings and the like, such as panels, partitions, false ceiling and the like, which element comprises:

- a rigid or semi-rigid element in the form of a slab, a section or the like;
- a layer of hardened plaster coated on the surface of said backing or part thereof;

- a one or multi-color decoration realized on said plaster by means of sublimable colors.

Claims

1. A process for the realization of structural and/or decorative elements for the building field, internal fittings, town-fittings, such as panels, partitions, door and window frames, false ceilings and the like, provided with one- or multi-color decorations, characterized in that it consists in the transfer and incorporation in a plaster layer coated on a backing from rigid or semi-rigid material of a sublimable color decoration, employing the transfer decoration technique.

2. The process according to claim 1, characterized in that it comprises the following steps:

- submitting said backing from rigid or semi-rigid material to one or more of degreasing, cleaning, surface conversion treatments, and anti-corrosion treatments in the case of metals, to anodizing treatments in case of aluminum and alloys thereof;
- submitting said so treated backing to one or more operations of pre-painting with colored paints, either opaque or transparent, suitable to form a primer base or layer;
- transferring on said treated and pre-painted backing a preparatory decoration with sublimable colors from a suitable flexible backing, by means of the transfer technique;
- coating said sublimable color decoration transferred on said backing with a plaster mortar layer;
- submitting to drying and heating said backing comprising said decoration and said layer of plaster mortar, according to a pre-fixed program, with ensuing hardening of said plaster and diffusion, surfacing and curing of said decoration on the surface of said hardened plaster.

3. The process according to claim 2, characterized in that said step of submitting to drying and heating said backing comprising said decoration and said plaster layer is carried out under pressure.

4. The process according to claim 3, characterized in that said pressure is comprised between 0,1 Ate and 7 Ate.

5. The process according to claim 1, characterized in that said material from which said rigid or semi-rigid backing is made is selected from among ferrous metals, non ferrous metals and light alloys, marble, stone, ceramics, bricks, cement-type materials,

glass, wood plates, and wood derivatives, special plastic materials and composites.

6. The process according to claim 1, characterized in that said backing from rigid or semi-rigid material is in the form of sheets, slabs, tubes, tapes, sections or the like, and may have a size of up to 8000x2000 mm.

7. The process according to claim 1, characterized in that said plaster layer has a thickness comprised between 0,5 mm and 5,0 mm.

8. The process according to claim 1, characterized in that said plaster has a porosity involving a permeability f comprised between 10^{-4} and 10^{-7} kg/(m²·sec), for gases having a specific weight for the ablative gases such as to allow weight capacities through the porous septum of from 0,16 to 2 g/(m²·sec).

9. The process according to claim 1, characterized in that said plaster is obtained from the plaster mortar called "Mighty CF" produced by MIGHTY KAGAKU Company, a Division of MIGHTY CHEMICAL CO, with headquarters in Japan.

10. The process according to claim 1, characterized in that it comprises the following steps:

- possibly submitting said backing from rigid or semi-rigid material to one or more degreasing, cleaning, possible surface conversion treatments, and anti-corrosion treatments in the case of metals, possible anodizing treatments in case of aluminum and alloys thereof;
- coating said backing with a plaster mortar layer of constant thickness;
- submitting to drying and heating said backing comprising said plaster mortar layer until said plaster has hardened;
- transferring on the hardened plaster present on said backing a sublimable color decoration from a suitable flexible backing, by means of the transfer technique.

11. A variously decorated structural and/or decorative element for the building field, fittings and the like, such as a panel, a partition, a false ceiling and the like, characterized in that it comprises:

- a rigid or semi-rigid backing in the form of a slab, a section or the like,
- a layer of hardened plaster coated on the surface of said backing or part thereof;
- a one or multi-color decoration realized on said plaster by means of sublimable colors.



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 3541

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X	EP 0 791 476 A (TODESCHINI DANILO) 27 August 1997 (1997-08-27) * example 1 *	1,2,4,9, 11	B41M5/035 B44C5/04 B44C1/17
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Place of search THE HAGUE		Date of completion of the search 13 October 2000	Examiner Herrmann, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P4/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 10 3541

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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