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(54) DECORATIVE FILM

(57) A decorative film (1), comprising:
a) a first layer (1a), of inert backing, chosen from:
- non-woven fabric made of glass fiber,
- non-woven fabric made of basalt fiber,
- glass fiber fabric,
- basalt fiber fabric,
- composite carbon and glass fiber fabric, and
- composite carbon and basalt fiber fabric; and

b) a second layer (1b), of a material chosen from paint, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof.

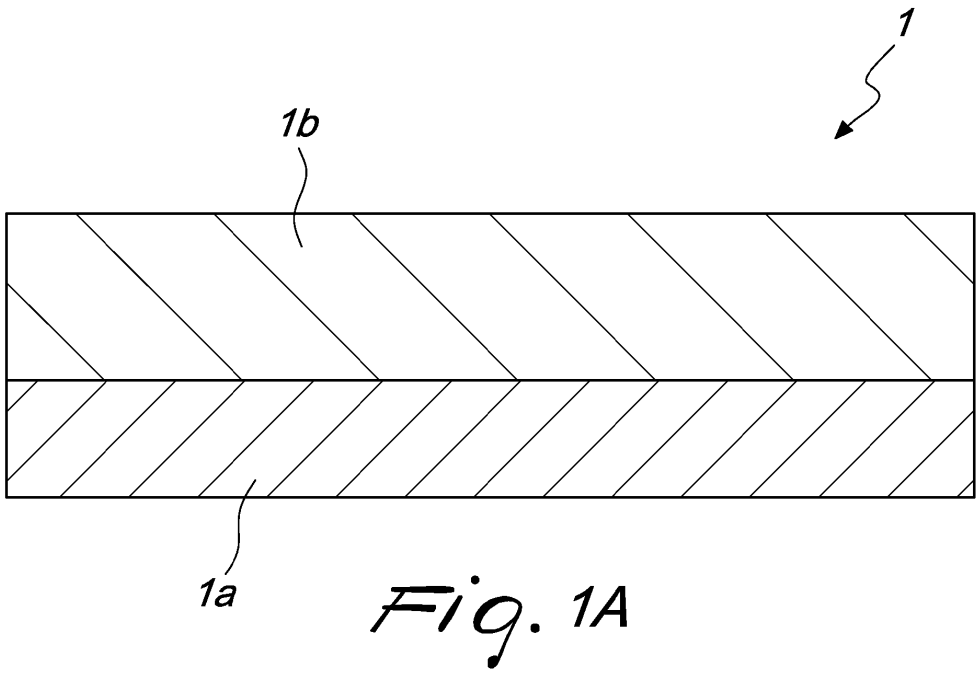

Fig. 1A

EP 4 163 123 A1

Description

[0001] The present invention relates to a decorative film.

[0002] Currently, surfaces intended for the manufacture of items of furniture are embellished mainly with technologies such as:

1) spray painting the surface to be embellished;
2) curtain painting the surface to be embellished;
3) applying a painted plastic film;
4) applying paper impregnated with thermosetting resins.

[0003] The above technologies present specific problems, however. In particular:

- spray painting is a slow process, with application speeds in the order of 5 m/min for automatic machines. The process is often carried out by hand by a specialist operator and is therefore expensive due to the low speed and the high impact of manual labor. Furthermore, from the environmental point of view, spray painting is basically polluting and entails significant investments for the abatement of aerosols.
- Curtain painting ensures high production speeds, but requires considerable amounts of paint to be spread, in the order of 120-150 g/m^2 when dry. Furthermore, these amounts are not applied in a single pass, but in several passes, occasionally necessitating rubbing with sandpaper between one pass and the next in order to ensure the correct adhesion of the subsequent layer on the underlying layer. The biggest problem is the overall cost of the process and the possibility of painting only flat surfaces.
- Painted plastic film has the advantage that it can be applied flat, post-formed, wrapped around a profile, or thermo-formed. The principal drawbacks are:

  a. Poor dimensional stability: for the backing on which the decorative film has been applied to stay flat over time, it is necessary to counterbalance it behind, i.e. apply (normally) a film of the same thickness as that applied on the exposed surface, so that the tendency of the film to shrink on the two sides is compensated;
  b. The amount of paint that can be applied on a plastic film is relatively low, normally comprised between 6 and 12 g/m^2 (6 - 12 micrometers). Therefore the surface strength characteristics are limited precisely because of the limited amount of paint that can be applied;
  c. The basic film, which has a thickness normally of between 180 and 500 micrometers, is expensive and presents a high difficulty of repeatability of colors, because the production process is carried out at high temperatures with a consequent increase in the risk of imperfectly controllable degradation of polymer and pigments.

- The application of paper impregnated with thermosetting resins is the embellishment method used more than any other, because it is the most economic. A decorative paper with variable grammage between 60 and 150 g/m^2 is impregnated with thermosetting resins and then pressed together with sheets or spools of Kraft paper, which is in turn impregnated with thermosetting resins, in order to obtain sheets of HPL (High Pressure Laminate) or spools of CPL (Continuous Press Laminate) to be glued with adhesive onto the panel to be embellished at high temperature in a multilevel press. The finishing is done by the surface of the plate that is in contact with the paper. During the heating process the resins react and harden. This type of embellishment is economic, given the low cost of paper and resins, but it results in a product with a medium-to-low appearance, of low quality owing to problems linked to the fragility of the impregnated paper, is not ideal from the environmental point of view owing to the use of urea-based and formaldehyde-based resins and phenolic resins, and is not very resistant to humid environments. In particular, solid colors have surface finishes that can normally be used only for parts of furniture that are not exposed to view, such as the sides and back.

[0004] The aim of the present invention is to provide a decorative film that ensures the peculiar aesthetic effect of technologies such as spray painting, curtain coating or curtain painting, while overcoming the drawbacks of the background art.

[0005] Within this aim, an object of the invention is to provide a decorative film that gives a high dimensional stability to the manufactured article to which it is applied, thus making it possible to limit, or even eliminate, the need to counterbalance the panels produced.

[0006] Another object of the invention is to provide a decorative film that can be wound on a spool, compatible with traditional application techniques such as calendering and wrapping.

[0007] Another object of the present invention is to provide a method for manufacturing the above mentioned decorative film.

[0008] Another object of the invention is to provide an apparatus that makes it possible to provide the decorative film of the invention in a highly reliable manner and at low cost.

[0009] This aim and these and other objects which will become better apparent hereinafter are achieved by a decorative film, characterized in that it comprises:

a) a first layer, of inert backing, chosen from:

- non-woven fabric made of glass fiber,
- non-woven fabric made of basalt fiber,

- glass fiber fabric,
- basalt fiber fabric,
- composite carbon and glass fiber fabric, and
- composite carbon and basalt fiber fabric; and

b) a second layer, of a material chosen from paint, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof.

[0010] The aim of the present invention is also achieved by a method for preparing a decorative film according to the invention, characterized in that it comprises the following steps:

(i) providing a first layer, of inert backing, chosen from:

- non-woven fabric made of glass fiber,
- non-woven fabric made of basalt fiber,
- glass fiber fabric,
- basalt fiber fabric,
- composite carbon and glass fiber fabric, and
- composite carbon and basalt fiber fabric;

(ii) applying to the first layer, of inert backing, a second layer, of a material chosen from paint, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof.

[0011] Furthermore, the aim and the objects of the invention are also achieved by an apparatus for manufacturing the decorative film according to the invention by way of the method according to the invention, characterized in that it comprises:

- an unwinding device for unwinding a backing spool, configured to manage thin and thick backings;
- at least one application head, adapted to apply one or more layers necessary for the construction of a decorative film;
- at least one drying device for each one of said at least one application head, configured as a function of the type of paint used;
- a printing device which can be selectively activated for a printed decorative film;
- at least one head for surface finishing;
- a device for applying a protective film, which can be selectively activated if required;
- a winding device, configured to wind films of medium-to-high thickness.

[0012] Finally, the aim and the objects of the invention are also achieved by the use of the decorative film according to the invention for embellishing a manufactured article chosen from an MDF (medium-density fiberboard) panel, a chipboard panel, a panel based on recycled materials, composite aluminum/PE (polyethylene) panels, composite MDF/aluminum panels, composite MDF/cellulose fiber panels, and panels made of composite material.

[0013] Further characteristics and advantages of the invention will become better apparent from the detailed description that follows and from the accompanying drawings wherein:

Figure 1A is a cross-sectional view of a decorative film according to the invention in a first embodiment thereof which comprises a first and a second layer;
Figure IB is a cross-sectional view of a decorative film according to the invention in a second embodiment thereof which comprises a first and a second layer, and a layer of protective paint;
Figure 1C is a cross-sectional view of a decorative film according to the invention in a third embodiment thereof which comprises a first and a second layer, and a decorative subject printed on the second layer;
Figure ID is a cross-sectional view of a decorative film according to the invention in a fourth embodiment thereof which comprises a first and a second layer, a decorative subject printed on the second layer, and a layer of protective paint on the decorative subject;
Figure 2 is a schematic diagram of an apparatus for manufacturing a decorative film according to the invention in a particular embodiment thereof;
Figure 3 is a table of the results of a test of resistance of a surface to cold liquids.

[0014] In a first aspect, with reference to Figure 1A, the present invention relates to a decorative film 1 which is characterized in that it comprises:

a) a first layer 1a, of inert backing, chosen from:

- non-woven fabric made of glass fiber,
- non-woven fabric made of basalt fiber,
- glass fiber fabric,
- basalt fiber fabric,
- composite carbon and glass fiber fabric, and
- composite carbon and basalt fiber fabric; and

b) a second layer 1b, of a material chosen from paint, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof.

[0015] In a preferred embodiment the first layer 1a of the decorative film of the invention is constituted by non-woven fabric made of glass fiber with a grammage comprised between 30 and 200 g/m^2, preferably 70 g/m^2.

[0016] In another preferred embodiment the first layer 1a of the decorative film of the invention is constituted

by non-woven fabric made of basalt fiber with a grammage comprised between 30 and 200 g/m^2, preferably 70 g/m^2.

[0017] In another preferred embodiment the first layer 1a of the decorative film of the invention is constituted by glass fiber fabric with a grammage comprised between 100 and 500 g/m^2.

[0018] In another preferred embodiment the first layer 1a of the decorative film of the invention is constituted by composite carbon and glass fiber fabric with a grammage comprised between 100 and 500 g/m^2.

[0019] In another preferred embodiment the first layer 1a of the decorative film of the invention is constituted by composite carbon and basalt fiber fabric with a grammage comprised between 100 and 500 g/m^2.

[0020] In one embodiment, with reference to Figure IB, the decorative film of the invention is characterized in that it comprises a finishing layer of paint 1c applied to said second layer 1b. The function of the finishing paint is to characterize the appearance of the manufactured article, for example with a contrasting luster effect, transparent or tinted, or relief effects, transparent or tinted.

[0021] In one embodiment of the decorative film of the invention, the second layer 1b is a layer of paint chosen from a water-based paint, a solvent-based paint, and a paint that can be polymerized using UV (ultraviolet) lamps, with a grammage comprised between 5 and 100 g/m^2, preferably between 10 and 30 g/m^2.

[0022] In another embodiment of the decorative film of the invention, said second layer 1b is a layer of a material chosen from mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof, of a thickness comprised between 0.2 and 1.5 mm, preferably between 0.3 and 0.6 mm.

[0023] The film of the invention, according to any one of the embodiments described above, with reference to Figures 1C and ID, can comprise a decorative subject Id.

[0024] The second layer 1b, which acts as a print medium, can be a layer of paint or, for example, but not exclusively, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement. A finishing layer of paint 1c can be applied to the decorative subject Id (Figure ID).

[0025] According to a second aspect, the present invention relates to a method for preparing a decorative film according to the invention, characterized in that it comprises the following steps:

(i) providing a first layer 1a, of inert backing, chosen from:

- non-woven fabric made of glass fiber,
- non-woven fabric made of basalt fiber,
- glass fiber fabric,
- basalt fiber fabric,
- composite carbon and glass fiber fabric, and
- composite carbon and basalt fiber fabric;

(ii) applying to the first layer 1a, of inert backing, a second layer 1b, of a material chosen from paint, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof.

[0026] The method of the invention can further comprise the step of iii) printing a decorative subject Id on said second layer 1b. Furthermore the method of the invention can further comprise the step of iv-a) applying a finishing layer of paint 1c on the second layer 1b or of iv-b) applying a finishing layer of paint 1c on the decorative subject Id.

[0027] In a third aspect the present invention relates to an apparatus for manufacturing the decorative film according to the invention by way of the method according to the invention, characterized in that it comprises:

- an unwinding device for unwinding a backing spool, configured to manage thin and thick backings;
- at least one application head, adapted to apply one or more layers necessary for the construction of a decorative film. For the intermediate layers the application heads need to be capable of handling products of medium and high viscosity (from 100 to 1200 centipoise (cP), typically 200-400 centipoise) and to be able to apply a grammage of between 20 and 800 g/m^2, typically 100-500 g/m^2, of product in a single pass.
- at least one drying device for each one of said at least one application head, configured as a function of the type of paint used;
- a printing device which can be selectively activated for a printed decorative film. The printing can be carried out using standard techniques, such as, typically but not exclusively, rotogravure printing, or with digital printing with water-based (latex) inks, solvent-based inks or UV-based inks. Typically UV-based inks are used;
- at least one head for surface finishing;
- a device for applying a protective film, which can be selectively activated if required; and
- a winding device, configured to wind films of medium-to-high thickness.

[0028] Not necessarily all of the operations need to be carried out in a production line. Typically it is possible to apply first the central structure and, in a second pass, the finishing paint. When the product is printed, the printing process is typically not in the production line, therefore the finishing paint is applied with a third pass.

[0029] In one embodiment, the unwinding device of the apparatus is provided with means for controlling the unwinding tension.

[0030] In one embodiment, the at least one application head is selected from the group consisting of a rotogravure head, a reverse rotogravure head, a roller coater

head, a reverse roller coater head, a comma blade head, a direct blade coating head, an indirect blade coating head, and a surface finishing head with screen printing technology. In particular, for the application of a single layer of paint, typically a roller coater or a comma blade is used, while for the application of the central aesthetic structure, direct spreading and a comma blade are used.

[0031] For a roller coater, the conventional conveyor mat has been eliminated, and also the counter roller has been replaced with a chrome-plated steel roller instead of a rubberized roller, and it has been made possible, on the reverse head, to work with the chrome-plated roller both when driven and when idle.

[0032] For screen printing, the dimensions of the steel rods that function as a doctor have been altered, developing rods characterized by high rigidity in order to be able to work with rods 4-6 millimeters in diameter without bending when applying materials of high viscosities.

[0033] In one embodiment, the at least one drying device is selected from the group consisting of: UV ovens with or without UVA (ultraviolet-A) LED pregel lamp for UV polymerization coating systems, hot air or IR (infrared) or NIR (near infrared) or combined ovens for water-based systems and hot air drying systems.

[0034] In greater detail, for solid color applications without intermediate layers, paint that can be polymerized with UV lamps is used, while for a grammage greater than 20 g/m^2 a UVA LED pregel lamp is typically used in order to ensure the polymerization of the inner layers of paint. Application speeds range from 5 to 50 m/min, typically 12-25 m/min, and the power of the UVA LED pregel lamp is between 6 and 20 kW, typically 12 kW. The number of UV polymerization lamps depends on the speed of the production line and on the power of the lamps, the number is normally comprised between 1 and 5, typically 2 or 3; the power between 80 and 120 W/cm, typically 120 W/cm. The lamps can be mercury or gallium, depending on the type of paint used, or a combination of the two lamps. In order to obtain particular surface effects, excimer UV lamps can also be added in order to obtain supermatt finishes.

[0035] For systems with a central aesthetic structure, hot air ovens with accurate temperature control are used in order to prevent the formation of a surface film that prevents the lower layers from drying. The drying temperature range varies between 60 and 150° C, typically a temperature gradient is used in the different sections of the oven starting at 70°C and rising to 120°C. The length of the oven depends on the grammage of the material applied.

[0036] Solvent-based systems can be used, but these create problems with treating the solvent.

[0037] In one embodiment, the at least one surface finishing head is selected from the group consisting of a rotogravure head, a reverse rotogravure head, a roller coater head, a reverse roller coater head, a comma blade head, a direct blade coating head, an indirect blade coating head, and a surface finishing head with screen printing technology.

[0038] The type of head depends on the paint used, on the grammage applied and on the final effect desired. Typically, direct or reverse rotogravure heads are used, and a roller coater, direct or in combination with a reverse rotogravure head. For effects in relief, screen printing is used.

[0039] For the surface finish, different types of paints can be used:

a. For a solid color, an additional surface finish is not necessary unless particular surface effects are desired such as typically, but not exclusively, gloss effects on matt finishes or vice versa, very deep gloss effects, gloss or matt relief effects. The surface finish system normally, but not necessarily, uses the same system of paints (UV or water) used for the tinted layer;

b. For a solid color in a film in which the second layer is made of a material chosen from mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof ("central aesthetic structure"), the surface finish can be applied using UV paints or using water-based paints. Solvent-based paints can also be used, but these create problems with treating the solvent. For UV paints, the grammage used can be between 8 and 50 g/m^2, typically 30 g/m^2, with the application speeds and the type of lamps described previously.

[0040] In more detail, such lamps have an UVA LED power comprised between 6 and 20 kW, typically 12 kW. The number of UV polymerization lamps depends on the speed of the production line and on the power of the lamps, the number is normally comprised between 1 and 5, typically 2 or 3, with power levels comprised between 80 and 120 W/cm, typically 120 W/cm.

[0041] In addition, the lamps can be mercury or gallium, depending on the type of paint used, or a combination of the two lamps. In order to obtain particular surface effects, excimer UV lamps can also be added in order to obtain supermatt finishes.

[0042] For water-based paints, typically, but not exclusively polyurethane-based or two-part acrylic, the grammage used is 10-100 g/m^2 when dry, typically 30-40 g/m^2. The drying speeds and temperatures are the same as those just described.

[0043] c. For a printed product, the same finishing paints and the same operating conditions as the previous point can be used.

[0044] The invention will now be described with reference to the following non-limiting examples.

EXAMPLE 1: SCRATCH RESISTANCE

[0045] A film is produced according to the invention with the following characteristics:

- a first layer of glass fiber, 62 g/m^2;
- a second layer made of cement-based resin + stone powders, 689.66 g/m^2;
- a finishing layer of paint 84 g/m^2;

[0046] Three test pieces of the above film were tested in order to evaluate their scratch resistance using the methods described in the UNI EN 15186:2012 standard ("FURNITURE - ASSESSMENT OF THE SURFACE RESISTANCE TO SCRATCHING").

[0047] In practice, for each test piece loads were applied in the range comprised between 5 and 0.1 Newtons (N) until the load that generates a continuous and visible trace (scratch) was identified. For each test piece, the scratch resistance is expressed as the minimum load that resulted in a continuous and visible sign. The final result of the sample analyzed is the average value obtained on three test pieces.

[0048] The film tested with the circular method (method B) showed an average scratch resistance value (expressed in Newtons) of 3.0.

[0049] On the basis of the UNI CEN/TS 16209:2011 standard, this corresponds to a use class A.

EXAMPLE 2: EFFECT OF EXPOSURE TO LIGHT

[0050] The film in example 1 was also tested to assess the effect of exposure to light, according to the UNI EN 15187:2007 standard.

[0051] The surface was subjected to an accelerated exposure to filtered radiation from a xenon arc lamp (50 rounds of irradiation in a device with humidity and radiation control from a xenon arc lamp filtered for 300-400 nm and power of 50 W/m^2) in order to assess the behavior of the surface area and the degree of variation of color. The properties of the exposed surface were compared with those of a masked-off section and with a test piece that was not exposed. The result was expressed with a numeric scale from 1 (worst) to 5 (no change), called a "gray scale", on the basis of the assessments of 3 observers. The assessment resulted in attributing a score of 5, corresponding to a resistance to light of >6.

EXAMPLE 3: RESISTANCE OF THE SURFACE TO COLD LIQUIDS

[0052] The film of example 1 was also tested to assess the resistance of the surface to cold liquids, according to the UNI EN 12720:2013 standard.

[0053] Disks saturated with the test liquids were positioned on the test surface and covered by a glass Petri dish. After a specified test period, the disks were removed and the test surface was allowed to rest for a time comprised between 16 and 24 hours. Subsequently, the test surface was cleaned and examined in order to identify the presence of any damage, such as for example discoloration, alteration of brilliance and color, bulging and the formation of blisters. The result of the test was assessed with reference to a numeric evaluation code on a scale from 1 (worst) to 5 (no defect).

[0054] The results are shown in Figure 3.

[0055] On the basis of the UNI CEN/TS 16209:2011 standard these results correspond to a use class A.

[0056] In practice it has been found that the device according to the invention fully achieves the set aim in that the product obtained presents a series of advantages:

a. Performance: the product ensures a high dimensional stability by virtue of the presence of the backing made of glass fiber or basalt fiber or carbon fiber. The dimensional stability obtained makes it possible to limit, or even eliminate, the need to counterbalance the panels produced. Furthermore, the surface resistance results obtained by the tests conducted at the COSMOB laboratory position the product at the high end of the performance range, ensuring results that normally are not obtainable on plastic films. Furthermore the structure of the product ensures a resistance to heat that exceeds that of plastic films, thus passing the standard tests of resistance to dry heat for kitchen worktops.

b. Appearance: the backing, which is basically not visible after application, makes it possible to have an embellished panel with the same aesthetic result obtained with technologies for direct application on the backing, such as spray painting, curtain coating or application by hand, but it can be used with standard industrial application technologies and, for application by hand, it makes it possible to cover surfaces with curved geometry, even complex surfaces, while obtaining a uniform appearance of the entire manufactured article, a result that is difficult to obtain with an application by hand on-site, especially at the points where the panels join.

c. Applicative: the possibility of having the product on a spool makes it possible to use traditional application techniques such as calendering and wrapping. Furthermore, given the structure of the product, the applicative aesthetic result is only minimally affected by the quality of spreading of the glue, differently from what happens with plastic films.

d. Economy: the use of inert backings behind in the grammage typically used enables a considerable saving over the use of plastic films. An inert backing costs 0.25 - 0.40 €/m^2 against 0.8 -1.2 €/m^2 for a plastic backing. The painting speeds are equivalent, any higher cost of the paint applied is typically around 0.2-0.3 €/m^2, thus ensuring the possibility of producing batches of colored films at reduced volumes, even in the order of 500-1000 m^2), an operation that is not feasible with plastic films, which have minimum batches of between 3000 and 5000 m^2.

[0057] The film and the apparatus, thus conceived, are susceptible of numerous modifications and variations, all

of which are within the scope of the appended claims; moreover, all the details may be substituted by other, technically equivalent elements.

[0058] In practice, the materials employed, as well as the dimensions, may be any according to requirements and to the state of the art.

[0059] The disclosures in Italian Patent Application No. 102021000025811 from which this application claims priority are incorporated herein by reference.

[0060] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A decorative film (1), **characterized in that** it comprises:

   a) a first layer (1a), of inert backing, chosen from:

   - non-woven fabric made of glass fiber,
   - non-woven fabric made of basalt fiber,
   - glass fiber fabric,
   - basalt fiber fabric,
   - composite carbon and glass fiber fabric, and
   - composite carbon and basalt fiber fabric; and

   b) a second layer (1b), of a material chosen from paint, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof.

2. The decorative film according to claim 1, **characterized in that** said first layer (1a), of inert backing, is chosen from:

   - non-woven fabric made of glass fiber with a grammage comprised between 30 and 200 g/m^2, preferably 70 g/m^2,
   - non-woven fabric made of basalt fiber with a grammage comprised between 30 and 200 g/m^2, preferably 70 g/m^2,
   - glass fiber fabric with a grammage comprised between 100 and 500 g/m^2, g/m^2,
   - basalt fiber fabric with a grammage comprised between 100 and 500
   - composite carbon and glass fiber fabric with a grammage comprised between 100 and 500 g/m^2, and
   - composite carbon and basalt fiber fabric with a grammage comprised between 100 and 500 g/m^2.

3. The decorative film according to claim 1 or 2, **characterized in that** it comprises a finishing layer of paint (1c) applied to said second layer (1b).

4. The decorative film according to one or more of the preceding claims, **characterized in that** said second layer (1b) is:

   a) a layer of paint chosen from a water-based paint, a solvent-based paint, and a paint that can be polymerized using UV (ultraviolet) lamps, with a grammage comprised between 5 and 100 g/m^2, preferably between 10 and 30 g/m^2; or
   b) a layer of a material chosen from mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof, of a thickness comprised between 0.2 and 1.5 mm, preferably between 0.3 and 0.6 mm.

5. A decorative film according to one or more of the preceding claims, **characterized in that** it comprises a decorative subject (Id).

6. A method for preparing a decorative film according to one or more of claims 1 to 5, **characterized in that** it comprises the following steps:

   (i) providing a first layer (1a), of inert backing, chosen from:

   - non-woven fabric made of glass fiber,
   - non-woven fabric made of basalt fiber,
   - glass fiber fabric,
   - basalt fiber fabric,
   - composite carbon and glass fiber fabric, and
   - composite carbon and basalt fiber fabric;

   (ii) applying to the first layer (1a), of inert backing, a second layer (1b), of a material chosen from paint, mortars, mortars loaded with natural fillers, resins loaded with powdered marble, resins loaded with powdered metals, microcement, and a combination thereof.

7. The method according to claim 6, **characterized in that** it comprises the step of iii) printing a decorative subject (Id) on said second layer (1b).

8. The method according to claim 6, **characterized in that** it comprises the step of iv-a) applying a finishing layer of paint (1c) on said second layer (1b).

9. The method according to claim 7, **characterized in that** it comprises the step of iv-b) applying a finishing layer of paint (1c) on said decorative subject (1d).

10. An apparatus for manufacturing a decorative film according to one or more of claims 1 to 5 by way of a method according to one or more of claims 6 to 9, **characterized in that** it comprises:

- an unwinding device for unwinding a backing spool, configured to manage thin and thick backings;
- at least one application head, adapted to apply one or more layers necessary for the construction of a decorative film;
- at least one drying device for each one of said at least one application head, configured as a function of the type of paint used;
- a printing device which can be selectively activated for a printed decorative film;
- at least one head for surface finishing;
- a device for applying a protective film, which can be selectively activated if required;
- a winding device, configured to wind films of medium-to-high thickness.

11. The apparatus according to claim 10, **characterized in that** said unwinding device is provided with means for controlling the unwinding tension.

12. The apparatus according to claim 10 or 11, **characterized in that** said at least one application head is selected from the group consisting of a rotogravure head, a reverse rotogravure head, a roller coater head, a reverse roller coater head, a comma blade head, a direct blade coating head, an indirect blade coating head, and a surface finishing head with screen printing technology.

13. The apparatus according to one or more of claims 10 to 12, **characterized in that** said at least one drying device is selected from the group consisting of: UV (ultraviolet) ovens with or without UVA (ultraviolet-A) LED pregel lamp for UV polymerization coating systems, hot air or IR (infrared) or NIR (near infrared) or combined ovens for water-based systems and hot air drying systems.

14. The apparatus according to one or more of claims 10 to 13, **characterized in that** said at least one surface finishing head is selected from the group consisting of a rotogravure head, a reverse rotogravure head, a roller coater head, a reverse roller coater head, a comma blade head, a direct blade coating head, an indirect blade coating head, and a surface finishing head with screen printing technology.

15. Use of the decorative film according to the invention for embellishing a manufactured article chosen from an MDF (medium-density fiberboard) panel, a chipboard panel, a panel based on recycled materials, composite aluminum/PE (polyethylene) panels, composite MDF/aluminum panels, composite MDF/cellulose fiber panels, and panels made of composite material.

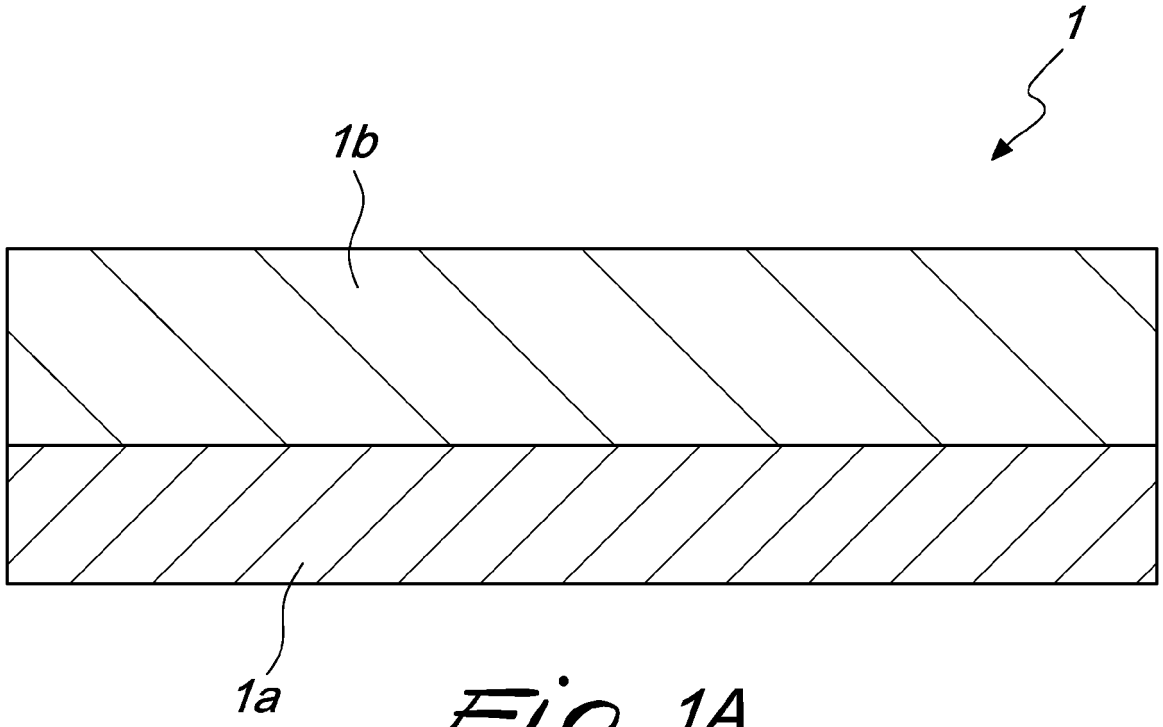

Fig. 1A

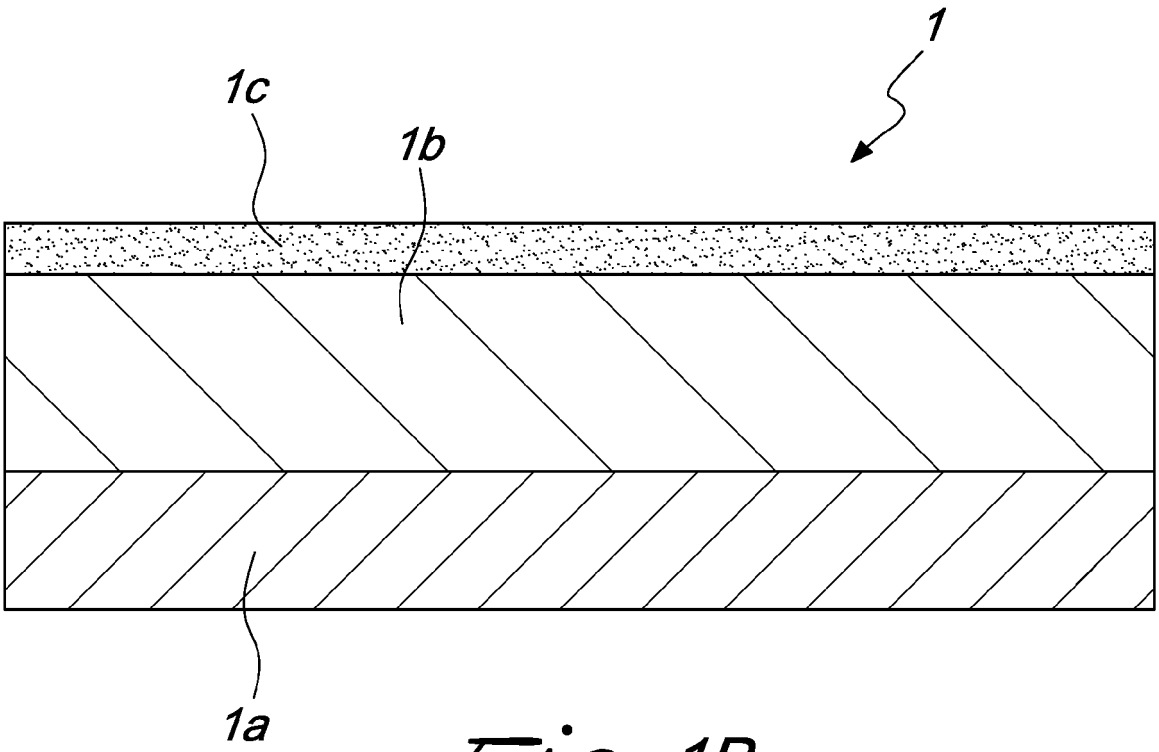

Fig. 1B

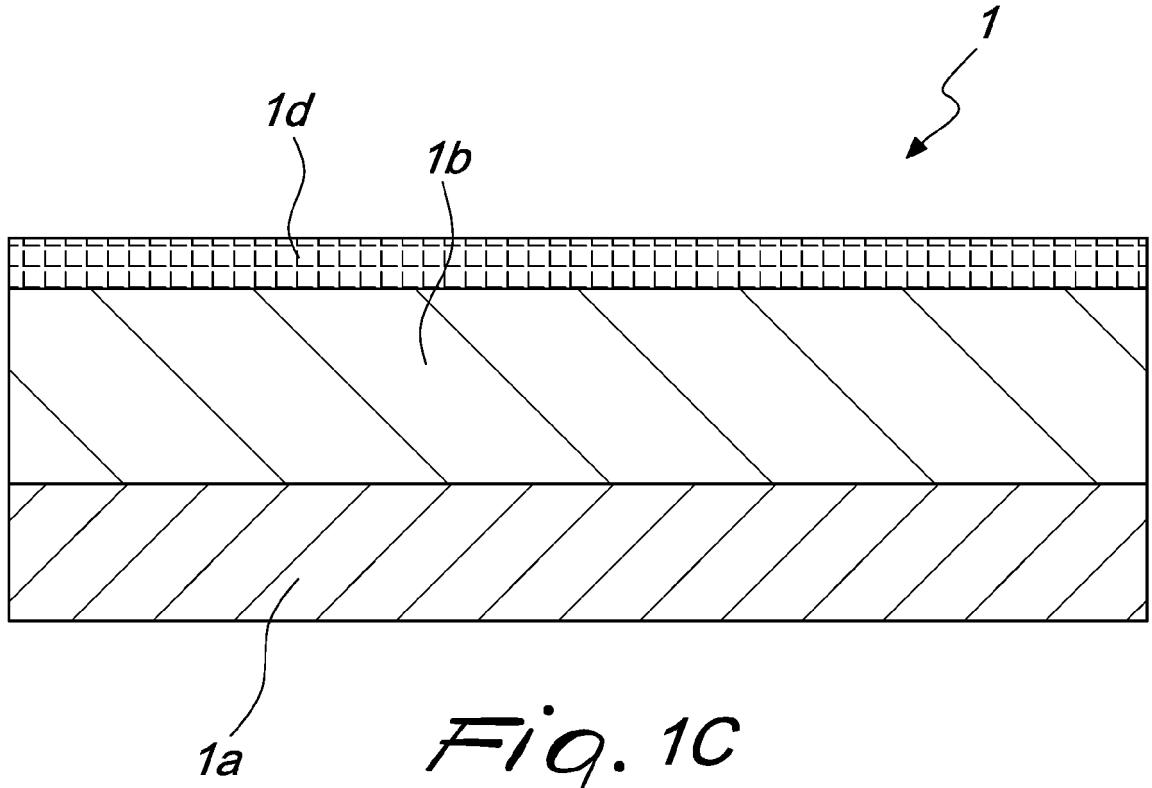

Fig. 1C

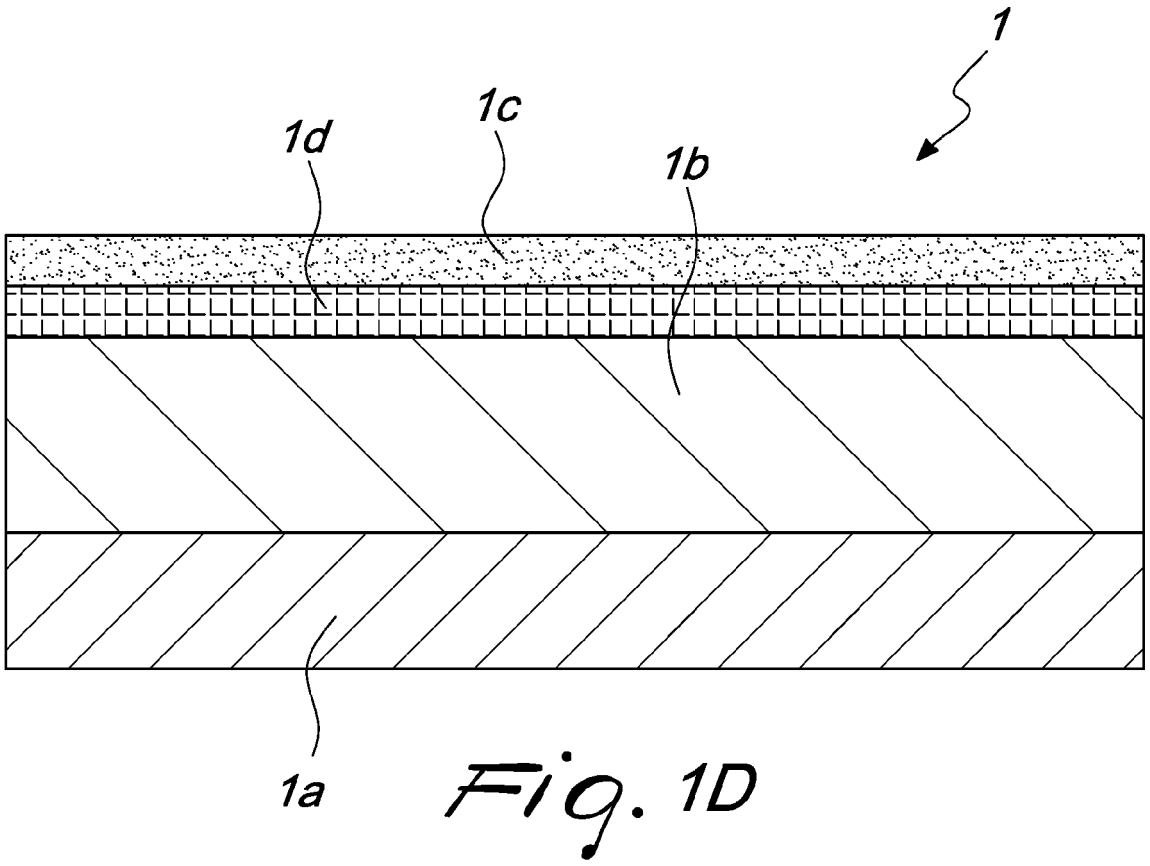

Fig. 1D

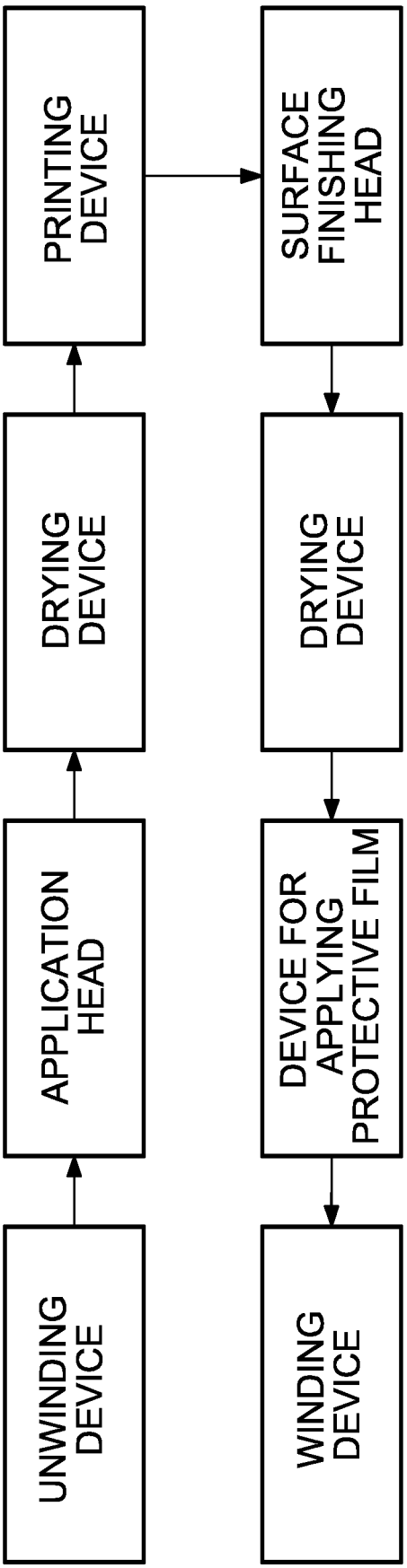
UNWINDING DEVICE
APPLICATION HEAD
DRYING DEVICE
PRINTING DEVICE
SURFACE FINISHING HEAD
DRYING DEVICE
DEVICE FOR APPLYING PROTECTIVE FILM
WINDING DEVICE

Fig. 2

Name of liquid	Application time 24 h	Application time 16 h	Application time 6 h	Application time 1 h	Application time 10 min	Application time 2 min	Application time 10 s
	Diffused light	Diffused light	Diffused light	Diffused light	Diffused light	Diffused light	Diffused light
Acetic acid (10% m/m)	-	5	5	5	5	5	5
Acetone	-	1	-	-	4	-	5
Ammonia (10% m/m)	-	5	5	5	5	5	5
Ethyl alcohol (48% V/V)	-	5	5	5	5	5	5
Citric acid (10% m/m)	-	5	5	5	5	5	5
Detergent solution	-	4	5	5	5	5	5
2 g of instant coffee in 50 ml of boiling water	-	5	5	5	5	5	5
Liquid paraffin	5	5	5	5	5	5	5
Deionized water	5	5	5	5	5	5	5
Basic sweat	-	5	5	5	5	5	5

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 9040

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Place of search	Date of completion of the search	Examiner
Munich	15 December 2022	Kelliher, Cormac

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