

Description

The present invention relates to processes and apparatus for decorating the surfaces of electron irradiation cured coatings on radiation-sensitive substrates as of paper, fabric, plastic, glass and other thin sheets, being more particularly directed to securing decorative layers to such substrates through the intermediary of electron-curable adhesive coatings cured upon the substrate.

In my earlier United States Letters Patent No. 4,246,297, there is disclosed the lamination between a thin radiation or heat-sensitive substrate, as of paper, fabric or other thin sheet, and a release paper or other layer of an electron-curable coating, as of adhesive properties with the electron energy and doses adjusted with reference to line speeds of the substrate to concentrate the energy in the curing of the coating while obviating degradation of the substrate, and with the peeling away of the release layer from the final product of the substrate with its electron-cured coating(s).

There are occasions, however, where it is desired to decorate the outer surface of the cured coating as with decorative layers, including metallized surfaces or patterns and the like. In accordance with the present invention it has been found possible to interpose a metal or similar decorative layer carried by the release layer, as of plastic, between the same and the electron-curable coating imparting to the coating adhesive properties such that, when cured, it will adhere to the metal or similar decorative layer, and the peeling away of the release layer from the coating cured on the substrate will transfer the metal or other decorative layer secured upon the outer surface of the coating.

An object of the present invention, accordingly, is to provide a new and improved process of and apparatus for electron-beam curing of adhesive or similar coatings upon a paper or similar radiation-sensitive substrate with a decorative layer interposed between the coating and the release paper to enable the decorative layer to become bonded to the cured coating and transferred from the release layer when it is peeled away after the curing.

A further object is to provide an electron-beam curing and layer transfer process of more general utility as well.

Other and further objects will be explained hereinafter and are more particularly delineated in the appended claims.

According to the invention there is provided a method of decorating an electron-beam curable adhesive coating upon a radiation-sensitive substrate, comprising, curing, by electron-beam irradiation, said adhesive coating between a release layer attached to the adhesive and the radiation-sensitive substrate, characterised by interposing a decorative layer between the adhesive coating and the release layer before said curing; adjusting the viscosity of the adhesive coating to stick to the decorative layer and, upon

the electron-beam curing of the adhesive layer, bonding to the decorative layer with an adhering force equal to or greater than a predetermined force required to strip the release layer from the decorative layer; pressing the assembly together; impinging electron beam radiation upon the pressed-together assembly and adjusting the beam to concentrate the principal energy within the coating to cure the same with minimal reaction upon the release layer, decorative layer and substrate of the assembly; and peeling the release layer from the substrate with its cured coating and adhered transferred decorative layer.

The invention will now be described in connection with the accompanying drawing, Fig. 1 of which is a schematic side elevation of a system employing the process of the invention; and

Fig. 2 is a similar but fragmentary view, upon an enlarged scale, of a modification.

Referring to Fig. 1, a radiation-sensitive substrate as before discussed, as of paper, is shown in web form 1, being fed to an electron-beam curable coating station 2, as of gravure or other rolls, for receiving the coating, such as an adhesive 3. Simultaneously, a release layer web, preferably non-moisture bearing, as of polyester or polypropylene plastic layers or films or the like 4 (such as Mylar), is fed in the same general direction with an attached decorative layer 5 on its inner surface, such as a mechanically attached vapor-deposited metallized decorative layer (requiring the before-mentioned non-moisture aspect in the in-vacuum vapor-deposition process, in sheet or pattern form.

The coated paper 1—3 and release layer with decorative layer 4—5 are pressed together at station 6 to provide an assembly where the release paper 4 now carries the electron-beam-curable adhesive layer 3 stuck to the decorative layer 5 and also carried by the paper substrate 1. The pressed-together assembly is passed under an electron-beam irradiation station 7, preferably of the type described in said United States Letters Patent No. 4,246,297 and in Patents Nos. 3,702,412, 3,745,396 and 3,769,600. Such electron processors accelerate a strip beam of low power energetic electrons (say 80 to 180 KeV) through an electron-permeable elongated window 7' simultaneously to impinge a uniform strip of elongated cross-sectional area electrons (into the plane of Fig. 1, transversely across the webs 1—4) perpendicularly upon the assembly 4—5—3—1. By adjusting the beam energy and dose and distance between the window and webs as described in said Letters Patent No. 4,246,297, within dose limits from substantially 0.5 to several megarads, the energy and dose can be substantially matched to the thicknesses of the materials of the adhesive-coated-decorated-layer-release paper sub-assembly 3—5—4 to the right of the lamination or pressure rolls 6, and of the substrate 1 to concentrate the principal energy substantially uniformly in the adhesive coating 3 while insuring minimal energy reaction with the release layer and substrate.

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In accordance with the discovery underlying the present invention, with appropriate viscosity ranges for the electron-beam curable adhesive coating 3, during cure under the radiation processor 7, it has been found that the decorative metallized layer 5 can become sufficiently bonded and permanently adhered to the cured coating 3 that when the release layer 4 is peeled away at 4', along the release line so-labelled, a force equal to or greater than that required to strip the deposited metallized decorative layer 5 from the release layer 4 is exerted, such that a cured coating adhered to the paper substrate 1 is produced with a transferred decorative metallized layer as the finished product 1'-3'-5'.

Suitable adhesive coatings for these purposes are, for example, the Hughson Chemicals Co. CD4171-63, with a viscosity range of from about 300 to 8000 centerpoise. The metallized decorative layer 5 may be of thickness to exhibit a resistance of the order of 2-6 ohms/square (120 to 40 nm) vacuum deposited on a coated Mylar film or layer 4 of about 25 μ m thickness. Under such circumstances, the stripping force to remove the deposited layer 5 from the release layer 4 is of the order of substantially 500 grams/inch (200 grams/cm), more or less; which, for the electron-beam curable adhesives above mentioned, in thicknesses after application of about 5-10 grams/square meter on the paper substrate 1 (of thicknesses of about 90 grams/square inch meter), is less than the adhesion force of the cured adhesive coating 3 bonded to the metallized layer 5, enabling stripping from the release layer 4 in a reliable manner.

As a typical example, with a Newton Falls C2S type paper in web form, about 18 inches (45 cm) across the web and travelling at a line speed of about 50 to 250 feet/minute (7.62 m/min) a polyurethane type adhesive coating of thickness after application of 5 grams/square meter (2 to 20 grams/square meter being particularly useful), a Mylar release film with a vapor-deposited aluminum metal layer 5 of about 40 nanometers in thickness (30-300 nanometers being a useful range), has been successfully assembled, cured and has produced a highly satisfactory product 1'-3'-5' with the Electrocurtain® processor of Energy Sciences Inc. operated with the window 7' about 2 cm from the release layer 4 and at a voltage of 200 KV and a dose of 3.0 megarads.

While the adhesive coating 3 is ultimately carried by the decorated release layer 4-5 beyond the lamination station 6 to the radiation processor 7, the coating 3 could have been applied directly to the decorative layer 5 instead of being applied thereto after deposition on the paper substrate 1. If desired, moreover, the metal or other decorative layer 5 may be attached to the inner surface of the release layer 4 other than by vapor-deposition. The decorative metal or other layer 5, moreover, may then be provided with a clear or other prime or protective coating on its surface, facing the inner surface of the release layer. For example, in Fig. 2, a release coat

adhesive 13 is shown used to attach a thin metal or other decorative layer or pattern 5''; and prime coat coating 13' may also be used, again deposited on the inner surface of the release film or layer 4. The assembly of the release layer 4 with its release coating 13 (and perhaps prime coating (13') attaching the decorative layer 5'', again laminated with the adhesive coating 3 and substrate 1, is then passed to the curing station 7, resulting in curing of the coatings such that the release paper and its cured release coat 13 peel away, leaving the decorative metal (or other) layer 5'' secured as a decoration bonded to the cured adhesive coating 3, and, if desired, with a cured protective prime coating 13' thereover. Suitable electron-beam curable coatings for such an assembly are adhesive coating 3-Mobil 187A; release coating 13-Mobil 145; prime coating 13'-Mobil 173.

Claims

1. A method of decorating an electron-beam curable adhesive coating upon a radiation sensitive substrate, comprising, curing, by electron-beam irradiation, said adhesive coating between a release layer attached to the adhesive and the radiation-sensitive substrate, characterised by interposing a decorative layer between the adhesive coating and the release layer before said curing; adjusting the viscosity of the adhesive coating to stick to the decorative layer and, upon the electron-beam curing of the adhesive layer, bonding to the decorative layer with an adhering force equal to or greater than a predetermined force required to strip the release layer from the decorative layer; pressing the assembly together; impinging electron beam radiation upon the pressed-together assembly and adjusting the beam to concentrate the principal energy within the coating to cure the same with minimal reaction upon the release layer, decorative layer and substrate of the assembly; and peeling the release layer from the substrate with its cured coating and adhered transferred decorative layer.

2. A process as claimed in claim 1 wherein the beam is adjusted to have a predetermined energy level selected within energy limits of from substantially 80 to 180 keV and the dose at that energy level to a predetermined value within dose limits of from substantially 0.5 to several megarads.

3. A process as claimed in claim 1 or 2 wherein said decorative layer is a metallized layer or layer pattern deposited upon the release layer, and removable therefrom upon application of at least said predetermined stripping force exerted by the peeling of the release layer from the cured adhesive coating cured to the substrate.

4. A process as claimed in any preceding claim wherein said release layer is of plastic sheet such as Mylar, and said substrate of paper.

5. A process as claimed in claim 4 wherein said predetermined stripping force is of the order of at least substantially 200 grams/cm, and said vis-

In accordance with the discovery underlying the present invention, with appropriate viscosity ranges for the electron-beam curable adhesive coating 3, during cure under the radiation processor 7, it has been found that the decorative metallized layer 5 can become sufficiently bonded and permanently adhered to the cured coating 3 that when the release layer 4 is peeled away at 4', along the release line so-labelled, a force equal to or greater than that required to strip the deposited metallized decorative layer 5 from the release layer 4 is exerted, such that a cured coating adhered to the paper substrate 1 is produced with a transferred decorative metallized layer as the finished product 1'-3'-5'.

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While the adhesive coating 3 is ultimately carried by the decorated release layer 4-5 beyond the lamination station 6 to the radiation processor 7, the coating 3 could have been applied directly to the decorative layer 5 instead of being applied thereto after deposition on the paper substrate 1. If desired, moreover, the metal or other decorative layer 5 may be attached to the inner surface of the release layer 4 other than by vapor-deposition. The decorative metal or other layer 5, moreover, may then be provided with a clear or other prime or protective coating on its surface, facing the inner surface of the release layer. For example, in Fig. 2, a release coat

adhesive 13 is shown used to attach a thin metal or other decorative layer or pattern 5''; and prime coat coating 13' may also be used, again deposited on the inner surface of the release film or layer 4. The assembly of the release layer 4 with its release coating 13 (and perhaps prime coating (13') attaching the decorative layer 5'', again laminated with the adhesive coating 3 and substrate 1, is then passed to the curing station 7, resulting in curing of the coatings such that the release paper and its cured release coat 13 peel away, leaving the decorative metal (or other) layer 5'' secured as a decoration bonded to the cured adhesive coating 3, and, if desired, with a cured protective prime coating 13' thereover. Suitable electron-beam curable coatings for such an assembly are adhesive coating 3-Mobil 187A; release coating 13-Mobil 145; prime coating 13'-Mobil 173.

Claims

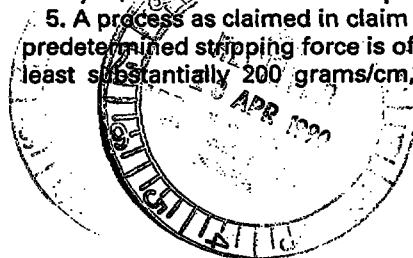
1. A method of decorating an electron-beam curable adhesive coating upon a radiation sensitive substrate, comprising, curing, by electron-beam irradiation, said adhesive coating between a release layer attached to the adhesive and the radiation-sensitive substrate, characterised by interposing a decorative layer between the adhesive coating and the release layer before said curing; adjusting the viscosity of the adhesive coating to stick to the decorative layer and, upon the electron-beam curing of the adhesive layer, bonding to the decorative layer with an adhering force equal to or greater than a predetermined force required to strip the release layer from the decorative layer; pressing the assembly together; impinging electron beam radiation upon the pressed-together assembly and adjusting the beam to concentrate the principal energy within the coating to cure the same with minimal reaction upon the release layer, decorative layer and substrate of the assembly; and peeling the release layer from the substrate with its cured coating and adhered transferred decorative layer.

2. A process as claimed in claim 1 wherein the beam is adjusted to have a predetermined energy level selected within energy limits of from substantially 80 to 180 keV and the dose at that energy level to a predetermined value within dose limits of from substantially 0.5 to several megarads.

3. A process as claimed in claim 1 or 2 wherein said decorative layer is a metallized layer or layer pattern deposited upon the release layer, and removable therefrom upon application of at least said predetermined stripping force exerted by the peeling of the release layer from the cured adhesive coating cured to the substrate.

4. A process as claimed in any preceding claim wherein said release layer is of plastic sheet such as Mylar, and said substrate of paper.

5. A process as claimed in claim 4 wherein said predetermined stripping force is of the order of at least substantially 200 grams/cm, and said vis-



cosity is in the range of substantially 300 to 8000 centerpoise.

6. A process as claimed in claim 5 wherein the thickness of the metallized decorative layer is of the order of about 30—300 nanometers, and the thickness of the adhesive coating corresponds to application of the order of about 2 to 20 g per 6.25 cm² (grams/square inch).

7. A process as claimed in any preceding claim wherein the decorative layer is attached to the release layer by one or more further coatings.

8. A process as claimed in claim 9 wherein said further coatings comprise a release coating adjacent the release layer.

9. A process as claimed in claim 8 wherein a prime coating is also provided between the release coating and the decorative layer.

10. Apparatus for carrying out the method as claimed in claim 1 comprising an electron-beam radiation processor disposed at a predetermined region of the path of travel of the substrate characterised by means for attaching the decorative layer to the inner surface of the release layer and feeding the same along said path of travel; means for pressure-laminating the substrate to the release-layer-decorative layer with electron-beam-curable adhesive interposed and for carrying the lamination through said predetermined region to cure the adhesive and bond the decorative layer thereto with a force greater than that required to strip the decorative layer from its attachment to the said inner surface of the release layer whereby the release layer may be peeled from the cured assembly to produce a substrate, coated by the cured adhesive with the decorative layer transferred to and bonded thereupon.

Patentansprüche

1. Verfahren zum Aufbringen eines Dekors auf eine durch einen Elektronenstrahl aushärtbare bzw. vernetzbare Klebstoffbeschichtung auf einem strahlungsempfindlichen Substrat, bei welchem die Klebstoffbeschichtung zwischen einer mit dieser verbundenen, jedoch ablösbaren Schicht und dem strahlungsempfindlichen Substrat durch Elektronenstrahlbehandlung ausgehärtet bzw. vernetzt wird, dadurch gekennzeichnet, daß vor dem Aushärten bzw. Vernetzen eine Dekorschicht zwischen die Klebstoffbeschichtung und die ablösbare Schicht eingebracht wird, daß die Viskosität der Klebstoffbeschichtung so eingestellt wird, daß diese an der Dekorschicht haftet, daß beim Elektronenstrahl-Vernetzen bzw. -Aushärten der Klebstoffbeschichtung diese mit der Dekorschicht mit einer solchen Haftkraft verbunden wird, die gleich oder größer ist als eine vorgegebene, zum Abziehen der ablösbaren Schicht von der Dekorschicht notwendige Abziehkraft, daß die Anordnung zusammengepreßt und die zusammengepreßte Anordnung der Bestrahlung mit dem Elektronenstrahl ausgesetzt wird, daß der Elektronenstrahl dabei so eingestellt wird, daß die Hauptenergie in der Klebstoffbeschichtung zu deren Vernetzen bzw. Aushärten

konzentriert ist, und zwar mit einer minimalen Einwirkung auf die ablösbare Schicht, auf die Dekorschicht sowie auf das Substrat der Anordnung, und daß dann die ablösbare Schicht von dem Substrat mit seiner vernetzten Klebstoffbeschichtung und der hieran haftenden, übertragenen Dekorschicht abgezogen wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Elektronenstrahl so eingestellt ist, daß ein vorgegebenes Energieniveau zwischen den Grenzwerten von ungefähr 80—180 keV erhalten wird und die Dosis bei diesem Energieniveau einen vorgegebenen Wert innerhalb der Grenzen von im wesentlichen 0,5 bis zu mehreren Megarad beträgt.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Dekorschicht eine metallisierte Schicht oder eine ein Muster bildende Schicht ist, die auf die ablösbare Schicht aufgebracht und von dieser entfernbar ist, und zwar bei Anwendung wenigstens der vorgegebenen Abziehkraft, die beim Abziehen der ablösbaren Schicht von der am Substrat ausgehärteten Klebstoffbeschichtung ausgeübt wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die ablösbare Schicht von einem Kunststoff-Flachmaterial, beispielsweise von Mylar, gebildet ist, und daß das Substrat Papier ist.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, daß die vorbestimmte Abziehkraft in der Größenordnung von wenigstens ungefähr 200 g/cm ist, und daß die Viskosität im Bereich zwischen ungefähr 300—8000 cPs liegt.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß die Dicke der metallisierten Dekorschicht in der Größenordnung von ungefähr 30—3000 Nanometern liegt, und daß die Dicke der Klebstoffbeschichtung in Abhängigkeit von der Anwendung in der Größenordnung von ungefähr 2—20 g/6,25 cm² (Gramm/Quadratzoll) beträgt.

7. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Dekorschicht an der ablösbaren Schicht durch eine oder mehrere zusätzliche Beschichtungen gehalten ist.

8. Verfahren nach Anspruch 9, dadurch gekennzeichnet, daß die zusätzlichen Beschichtungen eine der ablösbaren Schicht benachbarte, ein Ablösen ermöglichende Beschichtung aufweisen.

9. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß eine Grundierungsbeschichtung zwischen der ablösbaren Schicht und der Dekorschicht vorgesehen wird.

10. Vorrichtung zum Durchführen des Verfahrens nach Anspruch 1, mit einer Elektronenstrahl-Bestrahlungseinrichtung, die an einem vorgegebenen Bereich die Bewegungsbahn eines Substrates angeordnet ist, gekennzeichnet durch Mittel zum Aufbringen der Dekorschicht auf die innere Oberfläche der ablösbaren Schicht sowie zum Fördern dieser ablösbaren Schicht entlang der Bewegungsbahn, durch Mittel zur Bildung eines Laminates unter Druck, bestehend aus dem



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Substrat, aus der mit der Dekorschicht versehenen ablösbaren Schicht sowie aus einem dazwischen angeordneten, durch Elektronenstrahl aushärtbarem bzw. vernetzbarem Klebstoff sowie zum Fördern diese Laminats durch den erwähnten vorgegebenen Bereich, um den Klebstoff auszuhärten bzw. zu vernetzen und die Dekorschicht mit dem Kleber zu verbinden, und zwar mit einer Haftkraft, die größer ist als diejenige Kraft, die zum Abziehen der Dekorschicht von der erwähnten inneren Oberfläche der ablösbaren Schicht erforderlich ist, wodurch die ablösbare Schicht von der ausgehärteten Anordnung abgezogen werden kann, um ein Substrat herzustellen, welches mit dem ausgehärteten Kleber bzw. der an diesen übertragenen und gehaltenen Dekorschicht beschichtet ist.

Revendications

1. Une méthode de décoration d'un revêtement adhésif pouvant être traité par un faisceau d'électrons sur un substrat sensible au rayonnement, comprenant: le traitement, par irradiation du faisceau d'électrons, dudit revêtement adhésif entre une couche détachable fixée à l'adhésif et le substrat sensible au rayonnement, caractérisée par l'interposition d'une couche décorative entre le revêtement adhésif et la couche détachable avant ledit traitement; le réglage de la viscosité du revêtement adhésif pour adhérer à la couche décorative et, lors d'un traitement par le faisceau d'électrons de la couche adhésive, être relié à la couche décorative avec une force d'adhésion égale ou supérieure à une force prédéterminée nécessaire pour arracher, de la couche décorative, la couche détachable; la compression de l'ensemble; l'amenée du rayonnement du faisceau d'électrons sur l'ensemble comprimé et le réglage du faisceau pour concentrer l'énergie principale à l'intérieur du revêtement afin de traiter ce dernier avec une réaction minimum sur la couche détachable, la couche décorative et le substrat de l'ensemble; et le pelage de la couche détachable du substrat avec son revêtement traité et sa couche décorative transférée et fixée.

2. Un procédé comme revendiqué à la revendication 1 dans lequel le faisceau est réglé pour présenter un niveau d'énergie prédéterminé choisi dans des limites d'énergie allant d'environ 80 à 180 keV et le dosage à ce niveau d'énergie a une valeur prédéterminée à l'intérieur de limites de dosage allant d'environ 0,5 à plusieurs megarads.

3. Un procédé comme revendiqué à la revendication 1 ou 2, dans lequel ladite couche décorative est une couche métallisée ou un motif de couche déposé sur la couche détachable, et pou-

vant être enlevé de cette dernière lors de l'application d'au moins ladite force prédéterminée d'arrachement exercée par le pelage de la couche détachable du revêtement adhésif traité sur le substrat.

4. Un procédé comme revendiqué dans une revendication précédente quelconque dans lequel ladite couche détachable est une feuille de matière plastique telle que du Mylar, ledit substrat étant du papier.

5. Un procédé comme revendiqué à la revendication 4 dans lequel ladite force prédéterminée d'arrachement est de l'ordre d'au moins environ 200 grammes/cm, ladite viscosité étant de l'ordre d'environ 300 à 800 centipoises.

6. Un procédé comme revendiqué à la revendication 5, dans lequel l'épaisseur de la couche décorative métallisée est de l'ordre d'environ 30 à 300 nanomètres, l'épaisseur du revêtement adhésif correspondant à une application de l'ordre d'environ 2 à 20 g par 6,25 cm² (grammes/pouce carré).

7. Un procédé comme revendiqué dans une revendication précédente quelconque dans lequel la couche décorative est fixée à la couche détachable par un ou plusieurs revêtements supplémentaires.

8. Un procédé comme revendiqué à la revendication 9, dans lequel lesdits revêtements supplémentaires comprennent un revêtement détachable placé de manière adjacente à la couche détachable.

9. Un procédé comme revendiqué à la revendication 8, dans lequel un revêtement primaire est également prévu entre la couche détachable et la couche décorative.

10. Appareil pour mettre en oeuvre la méthode revendiquée à la revendication 1 comprenant un dispositif de traitement à rayonnement d'un faisceau d'électrons placé au niveau d'une zone déterminée à l'avance du trajet de déplacement du substrat, caractérisé par des moyens pour fixer la couche décorative à la surface interne de la couche détachable et amener celle-ci le long dudit trajet de déplacement; des moyens pour feuilleter sous pression le substrat sur la couche détachable-couche décorative avec interposition de l'adhésif traitable par le faisceau d'électrons et pour transporter le feuilleté à travers ladite zone déterminée à l'avance afin de traiter l'adhésif et de relier la couche décorative à ce dernier avec une force supérieure à celle nécessaire pour arracher la couche décorative de sa fixation à ladite surface interne de la couche détachable de sorte que la couche détachable peut être pelée de l'ensemble traité pour produire un substrat revêtu de l'adhésif traité auquel la couche décorative est transférée et reliée.

