US00RE42541E

(19) **United States**

(12) **Reissued Patent**

Dalvey et al.

(10) **Patent Number: US RE42,541 E**

(45) **Date of Reissued Patent: Jul. 12, 2011**

(54) **IMAGE TRANSFER SHEET**

(75) Inventors: **Jody A. Dalvey**, Orono, MN (US); **Nabill F. Nasser**, Minneapolis, MN (US)

(73) Assignee: **Jodi A. Schwendimann**, Plymouth, MN (US)

(21) Appl. No.: **11/054,717**

(22) Filed: **Feb. 9, 2005**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **6,551,692**
Issued: **Apr. 22, 2003**
Appl. No.: **09/150,983**
Filed: **Sep. 10, 1998**

(51) **Int. Cl.**
B41M 5/50 (2006.01)

(52) **U.S. Cl.** **428/32.12**; 428/32.24

(58) **Field of Classification Search** 428/32.12; 503/227

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,790,439 A 2/1974 La Perre et al.
3,922,435 A 11/1975 Asnes
4,102,456 A 7/1978 Morris
4,169,169 A 9/1979 Kitabatake
4,224,358 A 9/1980 Hare

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0466503 7/1990
EP 0 466 503 * 10/1992
EP 0782931 A1 7/1997
EP 0881092 A2 12/1998
EP 0899121 A1 3/1999
EP 0933225 A1 8/1999
GB 2295973 A 6/1996
JP 63122592 5/1988
JP 1037233 2/1989
JP 7276833 10/1995
JP 8085269 4/1996
WO WO-0073570 A1 12/2000

OTHER PUBLICATIONS

"U.S. Appl. No. 10/911,249 Response to Final Office Action filed Jan. 24, 2007", 8 pgs.
"U.S. Appl. No. 10/911,249 Response to Final Office Action filed Jan. 26, 2006", 7 pgs.
"U.S. Appl. No. 10/911,249 Response to Final Office Action filed Jan. 30, 2006", 7 pgs.
"U.S. Appl. No. 10/911,249 Response to Final Office Action filed Jul. 11, 2007", 11 pgs.
"U.S. Appl. No. 10/911,249 Response to Non–Final Office Action filed May 4, 2005", 6 pgs.

(Continued)

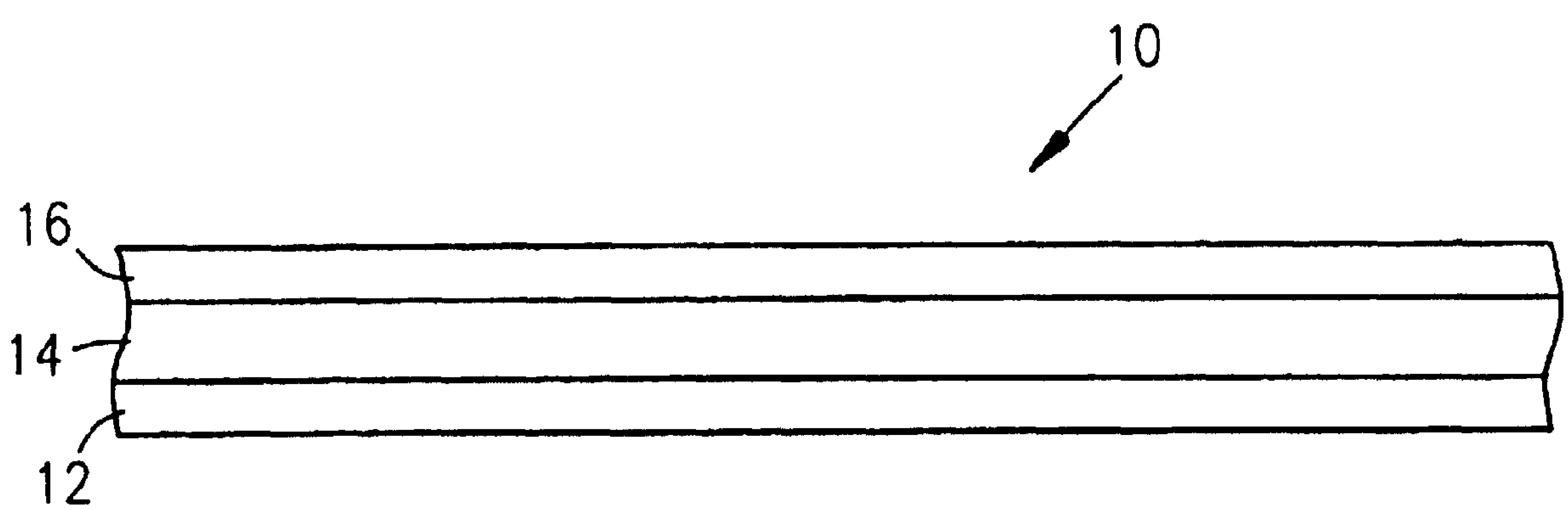
Primary Examiner—Bruce H Hess

(74) *Attorney, Agent, or Firm*—Schwegman Lundberg & Woessner, P.A.

(57) **ABSTRACT**

The present invention includes a method for transferring an image from one substrate to another. The method includes providing an image transfer sheet that is comprised of a substrate layer, a release layer and an image-imparting layer that may comprise a low density polyethylene or other polymeric component having a melting temperature within a range of 90°–700° C. An image is imparted to the low density polyethylene area with an image-imparting medium. A second image-receiving substrate is provided. The second image-receiving substrate is contacted to the first image transfer sheet at the polymer layer. Heat is applied to the image transfer sheet so that the low density polyethylene encapsulates the image-imparting medium and transfers the encapsulates to the image-receiving substrate, thereby forming a mirror image on the image-receiving substrate.

20 Claims, 1 Drawing Sheet



U.S. PATENT DOCUMENTS

4,235,657 A 11/1980 Greenman et al.
4,284,456 A 8/1981 Hare
4,399,209 A 8/1983 Sanders et al.
4,461,793 A 7/1984 Blok et al.
4,548,857 A 10/1985 Galante
4,549,824 A 10/1985 Sachdev et al.
4,594,276 A 6/1986 Relyea
4,685,984 A 8/1987 Powers et al.
4,758,952 A 7/1988 Harris, Jr. et al.
4,863,781 A 9/1989 Kronzer
4,880,678 A 11/1989 Goffi
4,966,815 A 10/1990 Hare
4,980,224 A 12/1990 Hare
5,019,475 A 5/1991 Higashiyama et al.
5,028,028 A 7/1991 Yamada et al.
5,045,383 A 9/1991 Maeda et al.
5,059,580 A 10/1991 Shibata et al.
5,097,861 A 3/1992 Hopkins et al.
5,110,389 A 5/1992 Hiyoshi et al.
5,133,819 A 7/1992 Croner
5,139,917 A 8/1992 Hare
5,217,793 A * 6/1993 Yamane et al. 428/212
5,236,801 A 8/1993 Hare
5,242,739 A 9/1993 Kronzer et al.
5,252,531 A 10/1993 Yasuda et al.
5,271,990 A 12/1993 Kronzer et al.
5,334,439 A 8/1994 Kawaguchi et al.
5,350,474 A 9/1994 Yamane
5,362,703 A 11/1994 Kawasaki et al.
5,372,884 A 12/1994 Abe et al.
5,400,246 A 3/1995 Wilson et al.
5,407,724 A 4/1995 Mimura et al.
5,431,501 A 7/1995 Hale et al.
5,434,598 A 7/1995 Shimomine et al.
5,501,902 A 3/1996 Kronzer
5,521,229 A 5/1996 Lu et al.
5,614,345 A 3/1997 Gumbiowski et al.
5,620,548 A 4/1997 Hare
5,665,476 A 9/1997 Oez
5,707,925 A 1/1998 Akada et al.
5,770,268 A 6/1998 Kuo et al.
5,798,161 A 8/1998 Kita et al.
5,798,179 A 8/1998 Kronzer
5,821,028 A * 10/1998 Maejima et al. 430/201
5,833,790 A 11/1998 Hare
5,861,355 A 1/1999 Olson et al.
5,905,497 A 5/1999 Vaughan et al.
5,917,730 A 6/1999 Rittie et al.
5,925,712 A 7/1999 Kronzer
5,942,335 A 8/1999 Chen et al.
5,948,586 A 9/1999 Hare
5,962,149 A 10/1999 Kronzer
5,981,045 A 11/1999 Kuwabara et al.
5,981,077 A 11/1999 Taniguchi
6,017,611 A 1/2000 Cheng et al.
6,033,739 A 3/2000 Kronzer
6,033,824 A 3/2000 Hare et al.
6,036,808 A 3/2000 Shaw-Klein et al.
6,042,914 A 3/2000 Lubar
6,054,223 A 4/2000 Tsuchiya et al.
6,066,387 A 5/2000 Ueda et al.
6,071,368 A 6/2000 Boyd et al.
6,083,656 A 7/2000 Hare et al.
6,087,061 A 7/2000 Hare et al.
6,090,520 A 7/2000 Hare et al.
6,096,475 A 8/2000 Hare et al.
6,106,982 A 8/2000 Mientus et al.
6,113,725 A 9/2000 Kronzer
6,120,888 A 9/2000 Dolsey et al.
6,139,672 A 10/2000 Sato et al.
6,177,187 B1 1/2001 Niemoller et al.
6,180,256 B1 1/2001 Sargeant
6,200,668 B1 3/2001 Kronzer
6,242,082 B1 6/2001 Mukoyoshi et al.
6,245,710 B1 6/2001 Hare et al.
6,258,448 B1 7/2001 Hare
6,265,128 B1 7/2001 Hare et al.
6,294,307 B1 9/2001 Hare et al.
6,331,374 B1 12/2001 Hare et al.
6,338,932 B2 1/2002 Hare et al.
6,340,550 B2 1/2002 Hare et al.
6,358,660 B1 3/2002 Agler et al.
6,383,710 B2 5/2002 Hare et al.
6,423,466 B2 7/2002 Hare et al.
6,428,878 B1 8/2002 Kronzer
6,450,633 B1 9/2002 Kronzer
6,495,241 B2 12/2002 Sato et al.
6,497,781 B1 12/2002 Dalvey et al.
6,506,445 B2 1/2003 Popat et al.
6,509,131 B2 1/2003 Hare et al.
6,521,327 B1 2/2003 Franke
6,531,216 B1 3/2003 Williams et al.
6,539,652 B1 4/2003 Barry
6,551,692 B1 4/2003 Dalvey et al.
6,582,803 B2 6/2003 Cole et al.
6,638,604 B1 10/2003 Bamberg et al.
6,638,682 B2 10/2003 Hare et al.
6,667,093 B2 12/2003 Yuan et al.
6,677,009 B2 1/2004 Boyd et al.
6,703,086 B2 3/2004 Kronzer et al.
6,723,773 B2 4/2004 Williams et al.
6,753,050 B1 6/2004 Dalvey et al.
6,786,994 B2 9/2004 Williams et al.
6,849,312 B1 2/2005 Williams
6,869,910 B2 3/2005 Williams et al.
6,871,950 B2 3/2005 Higuma et al.
6,875,487 B1 4/2005 Williams et al.
6,878,423 B2 4/2005 Nakanishi
6,884,311 B1 4/2005 Dalvey et al.
6,916,589 B2 7/2005 Hare et al.
6,916,751 B1 7/2005 Kronzer
6,951,671 B2 10/2005 Mukherjee et al.
6,998,211 B2 2/2006 Riley et al.
7,001,649 B2 2/2006 Wagner et al.
7,008,746 B2 3/2006 Williams et al.
7,021,666 B2 4/2006 Hare
7,022,385 B1 4/2006 Nasser
7,026,024 B2 4/2006 Chang et al.
7,081,324 B1 7/2006 Hare et al.
7,160,411 B2 1/2007 Williams et al.
7,220,705 B2 5/2007 Hare
7,238,410 B2 7/2007 Kronzer
7,361,247 B2 4/2008 Kronzer
7,364,636 B2 4/2008 Kronzer
2001/0051265 A1 12/2001 Williams et al.
2002/0025208 A1 2/2002 Sato et al.
2002/0048656 A1 4/2002 Sato et al.
2002/0192434 A1 12/2002 Yuan et al.
2003/0008112 A1 1/2003 Cole et al.
2003/0021962 A1 1/2003 Mukherjee et al.
2004/0100546 A1 5/2004 Horvath
2004/0146700 A1 7/2004 Boyd et al.
2005/0048230 A1 3/2005 Dalvey et al.
2007/0172609 A1 7/2007 Williams
2007/0172610 A1 7/2007 Williams
2007/0221317 A1 9/2007 Knonzer et al.
2007/0231509 A1 10/2007 Xu et al.
2008/0149263 A1 6/2008 Dalvey et al.
2008/0302473 A1 12/2008 Dalvey et al.
2008/0305253 A1 12/2008 Dalvey et al.
2008/0305288 A1 12/2008 Dalvey et al.

OTHER PUBLICATIONS

"U.S. Appl. No. 10/911,249 Response to Notice of Non--Compliant Amendment filed Jun. 2, 2005", 5 pgs.
"International Application No. PCT/US99/20823 International Preliminary Examination Report mailed Sep. 19, 2000", 14 pgs.
"International Application No. PCT/US99/20823 PCT Search Report mailed Dec. 13, 1999", 8 pgs.
"International Application No. PCT/US99/20823 PCT Written Opinion mailed May 16, 2000", 15 pgs.
"U.S. Appl. No. 12/034,932, Non–Final Office Action mailed Sep. 10, 2009", 5 pgs.
"U.S. Appl. No. 12/193,573, Non–Final Office Action mailed Sep. 11, 2009", 5 pgs.
"U.S. Appl. No. 12/193,578, Non–Final Office Action mailed Sep. 11, 2009", 5 pgs.
"U.S. Appl. No. 10/911,249, Final Office Action mailed Jun. 30, 2009", 5 pgs.
"U.S. Appl. No. 10/911,249, Response filed Nov. 30, 2009 to Non–Final Office Action mailed Sep. 21, 2009", 17 pgs.
"U.S. Appl. No. 12/193,562, Non–Final Office Action mailed Sep. 9, 2009", 5 Pgs.
"U.S. Appl. No. 12/193,562, Response filed Dec. 9, 2009 to Non–Final Office Action mailed Sep. 9, 2009", 17 pgs.
"U.S. Appl. No. 12/193,573, Response filed Jun. 15, 2009 to Non Final Office Action mailed Apr. 7, 2009", 19 pgs.
"U.S. Appl. No. 12/193,578, Response filed Jun. 15, 2009 to Non–Final Office Action mailed Feb. 11, 2009", 16 pgs.
"U.S. Appl. No. 10/911,249 Response filed Jan. 5, 2009 to Final Office Action mailed Dec. 5, 2008", 10 pgs.
"U.S. Appl. No. 10/911,249 Response filed Nov. 24, 2008 to Final Office Action mailed Oct. 22, 2008", 25 pgs.
"U.S. Appl. No. 10/911,249 Response filed Mar. 11, 2009 to Final Office Action mailed Feb. 9, 2009", 13 pgs.
"U.S. Appl. No. 12/193,573 Non–Final Office Action mailed Apr. 7, 2009", 11 pgs.
"U.S. Appl. No. 12/193,578 Non–Final Office Action mailed Feb. 11, 2009", 12 pgs.
"U.S. Appl. No. 12/218,260 Non–Final Office Action mailed Jan. 2, 2009", 11 pgs.
"U.S. Appl. No. 12/218,260 Response filed Apr. 2, 2009 to Non Final Office Action mailed Jan. 2, 2009", 7 pgs.
"U.S. Appl. No. 09/150,983, Notice of Allowance mailed Nov. 19, 2002", 8 pgs.
"U.S. Appl. No. 09/150,983, Response to Non–Final Office Action filed Aug. 7, 2002", 9 pgs.
"U.S. Appl. No. 09/541,845, Final Office Action mailed Nov. 25, 2003", 4 pgs.
"U.S. Appl. No. 09/541,845, Non–Final Office Action mailed Apr. 16, 2003", 4 pgs.
"U.S. Appl. No. 09/541,845, Notice of Allowance mailed May 4, 2004", 4 pgs.
"U.S. Appl. No. 09/541,845, Response filed Mar. 23, 2004 to Final Office Action mailed Nov. 25, 2003", 6 pgs.
"U.S. Appl. No. 09/541,845, Response filed Jul. 15, 2003 to Non–Final Office Action mailed Apr. 14, 2003", 5 pgs.
"U.S. Appl. No. 09/541,845, Supplemental Notice of Allowability mailed Jan. 26, 2005", 2 pgs.
"U.S. Appl. No. 09/661,532, Final Office Action mailed May 20, 2003", 8 pgs.
"U.S. Appl. No. 09/661,532, Non–Final Office Action mailed Mar. 1, 2002", 9 pgs.
"U.S. Appl. No. 09/661,532, Notice of Allowance mailed Feb. 12, 2004", 4 pgs.
"U.S. Appl. No. 09/661,532, Response filed Aug. 20, 2003 to Final Office Action mailed May 20, 2003", 5 pgs.
"U.S. Appl. No. 09/661,532, Response filed Aug. 30, 2002 to Non–Final Office Action mailed Mar. 1, 2002", 8 pgs.
"U.S. Appl. No. 10/719,220, Non–Final Office Action mailed Sep. 9, 2004", 3 pgs.
"U.S. Appl. No. 10/719,220, Preliminary Amendment filed Nov. 21, 2003", 3 pgs.
"U.S. Appl. No. 10/911,249, Response filed Jul. 29, 2008 to Final Office Action mailed Jan. 29, 2008", 19 pgs.
"U.S. Appl. No. 10/911,249, Preliminary Amendment mailed Jun. 4, 2004", 4 pgs.
"U.S. Appl. No. 10/911,249, Response filed Jul. 11, 2007 to Non–Final Office Action Mar. 13, 2007", 11 pgs.
"U.S. Appl. No. 10/911,249, Final Office Action mailed Jan. 29, 2008", 6 pgs.
"U.S. Appl. No. 10/911,249 Notice of Allowance mailed Mar. 25, 2008", 4 pgs.
"U.S. Appl. No. 10/911,249 Response to Final Office Action filed Feb. 18, 2008", 7 pgs.
"U.S. Appl. No. 10/911,249 Response filed Dec. 14, 2007 to Office Action mailed Sep. 20, 2007", 9 pgs.
"International Application Serial No. PCT/US00/24633, International Search Report mailed Nov. 30, 2000", 7 pgs.
"U.S. Appl. No. 09/150,983 Notice of Allowance Nov. 19, 2002", 8 pgs.
"U.S. Appl. No. 09/150,983 Response to Non–Final Office Action Aug. 7, 2002", 13 pgs.
"U.S. Appl. No. 09/150,983 Final Office Action Aug. 2, 2000", 10 pgs.
"U.S. Appl. No. 09/150,983 Non–Final Office Action Jan. 30, 2001", 7 pgs.
"U.S Appl. No. 09/150,983 Non–Final Office Action Dec. 28. 1999", 7 pgs.
"U.S. Appl. No. 09/150,983 Non–Final Office Action Apr. 11, 2000", 6 pgs.
"U.S. Appl. No. 09/150,983 Response to Non–Final Office Action Feb. 16, 2000", 8 pgs.
"U.S. Appl. No. 09/150,983 Response to Non–Final Office Action Jun. 20, 2000", 9 pgs.
"U.S. Appl. No. 09/535,937 Notice of Allowance Sep. 10, 2002", 9 pgs.
"U.S. Appl. No. 09/535,937 Non–Final Office Action Nov. 29, 2001", 10 pgs.
"U.S. Appl. No. 09/535,937 Response to Non–Final Office Action May 28, 2002", 9 pgs.
"U.S. Appl. No. 10/911,249 Final Office Action filed Dec. 14, 2006", 3 pgs.
"U.S. Appl. No. 10/911,249 Final Office Action filed Dec. 8, 2006", 3 pgs.
"U.S .Appl. No. 10/911,249 Final Office Action filed Jul. 26, 2005", 3 pgs.
"U.S. Appl. No. 10/911,249 Non–Final Office Action filed Feb. 8, 2005", 5 pgs.
"U.S. Appl. No. 10/911,249 Non–Final Office Action filed Mar. 13, 2007", 4 pgs.
"U.S. Appl. No. 10/911,249 Non–Final Office Action mailed Sep. 20, 2007", OARN,5 pgs.

* cited by examiner

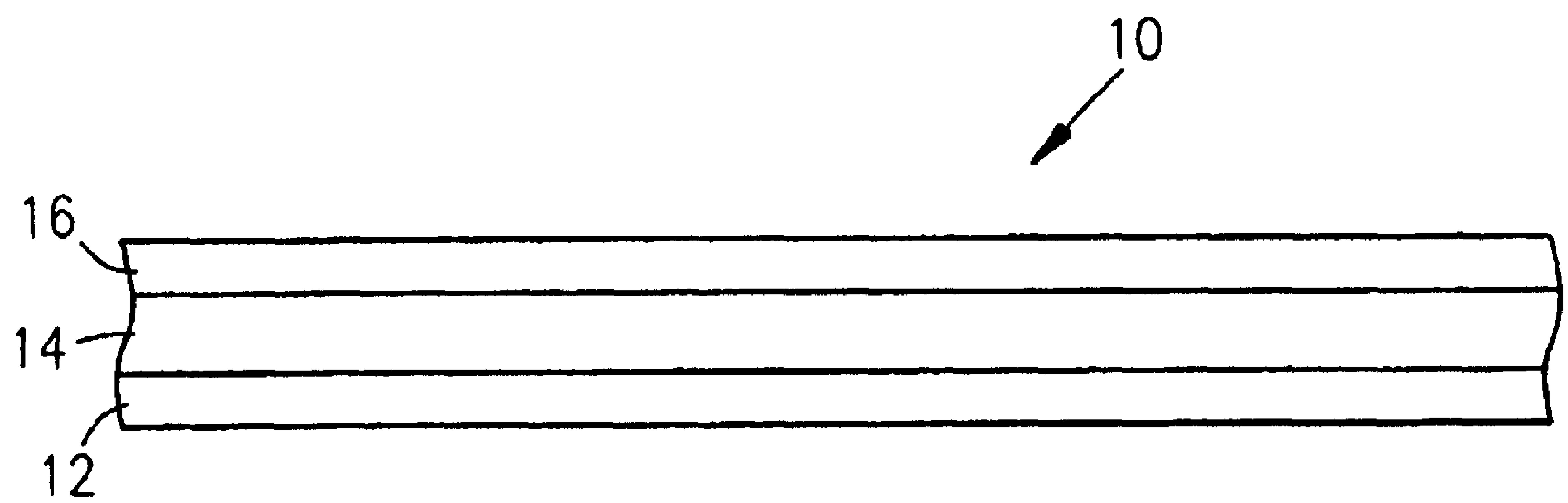

10
16
14
12

IMAGE TRANSFER SHEET

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

The present invention relates to an image transfer sheet and to a method for making the image transfer sheet.

Image transfer to articles made from materials such as fabric, nylon, plastics and the like has increased in popularity over the past decade due to innovations in image development. On Feb. 5, 1974, La Perre et al. had issue a United States Patent describing a transfer sheet material markable with uniform indicia and applicable to book covers. This sheet material included adhered plies of an ink-receptive printable layer and a solvent-free, heat-activatable adhesive layer. The adhesive layer was somewhat tacky prior to heat activation to facilitate positioning of a composite sheet material on a substrate which was to be bonded. The printable layer had a thickness of 10–500 microns and had an exposed porous surface of thermoplastic polymeric material at least 10 microns thick.

Indicia were applied to the printable layer with a conventional typewriter. A thin film of temperature-resistant, low surface energy polymer, such as polytetrafluoroethylene, was laid over the printed surface and heated with an iron. Heating caused the polymer in the printable layer to fuse thereby sealing the indicia into the printable layer.

On Sep. 23, 1980, Hare had issue U.S. Pat. No. 4,224,358, which described a kit for applying a colored emblem to a t-shirt. The kit comprised a transfer sheet which included the outline of a mirror image of a message. To utilize the kit, a user applied a colored crayon to the transfer sheet and positioned the transfer sheet on a t-shirt. A heated instrument was applied to the reverse side of the transfer sheet in order to transfer the colored message.

The Greenman et al. patent, U.S. Pat. No. 4,235,657, issuing Nov. 25, 1980, described a transfer web for a hot melt transfer of graphic patterns onto natural, synthetic fabrics. The transfer web included a flexible substrate coated with a first polymer film layer and a second polymer film layer. The first polymer film layer was made with a vinyl resin and a polyethylene wax which were blended together in a solvent or liquid solution. The first film layer served as a releasable or separable layer during heat transfer. The second polymeric film layer was an ionomer in an aqueous dispersion. An ink composition was applied to a top surface of the second film layer. Application of heat released the first film layer from the substrate while activating the adhesive property of the second film layer thereby transferring the printed pattern and a major part of the first layer along with the second film layer onto the work piece. The second film layer bonded the printed pattern to the work piece while serving as a protective layer for the pattern.

The Sanders et al. patent, U.S. Pat. No. 4,399,209, issuing Aug. 16, 1983, describes an imaging system in which images were formed by exposing a photosensitive encapsulate to actinic radiation and rupturing the capsules in the presence of a developer so that there was a pattern reaction of a chromogenic material present in the encapsulate or co-deposited on a support with the encapsulate and the developer which yielded an image.

The Goffi patent, U.S. Pat. No. 4,880,678, issuing Nov. 14, 1989, describes a dry transfer sheet that comprises a

colored film adhering to a backing sheet with an interposition of a layer of release varnish. The colored film included 30%–40% pigment, 1%–4% of cycloaliphatic epoxy resin, from 15%–35% of vinyl copolymer and from 1%–4% of polyethylene wax. This particular printing process was described as being suitable for transferring an image to a panel of wood.

The Kronzer et al. patent, U.S. Pat. No. 5,271,990, issuing Dec. 21, 1993, describes an image-receptive heat transfer paper that included a flexible paper based web base sheet and an image-receptive melt transfer film that overlaid a top surface of the base sheet. The image-receptive melt transfer film was comprised of a thermoplastic polymer melting at a temperature within a range of 65°–180° C.

The Higashiyami et al. patent, U.S. Pat. No. 5,019,475, issuing May 28, 1991, describes a recording medium that included a base sheet, a thermoplastic resin layer formed on at least one side of the base sheet and a color developer layer formed on a thermoplastic resin layer and capable of color development by reaction with a dye precursor.

DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a cross-sectional view of one embodiment of the image transfer sheet of the present invention.

SUMMARY OF THE INVENTION

One embodiment of the present invention includes a method for transferring an image from one substrate to another. The method comprises providing an image transfer sheet which is comprised of a substrate layer, a release layer and an image-imparting layer that comprises a polymer component such as a low density polyethylene (LDPE) or Ethylene Acrylic Acid (EAA) or Ethylene Vinyl Acetate (EVA) or Methane Acrylic Ethylene Acrylic (MAEA) or mixtures of these materials, each having a melt index within a range of 20–1,200 C-g/10 minute (SI). An image is imparted to the polymer component of the image imparting layer through an image imparting medium such as ink or toner.

In one embodiment, an image-receiving substrate is also provided. The image-receiving substrate is contacted to the image transfer sheet and is specifically contacted to the polymer component of the image imparting layer. Heat is applied to the substrate layer of the image transfer sheet and is transferred to the polymer component of the image imparting layer so that the polymer, such as the LDPE, EAA, or EVA or MAEA encapsulates the image-imparting medium and transfers the encapsulates to the image-receiving substrate thereby forming a mirror image on the image-receiving substrate.

One other embodiment of the present invention includes an image transfer sheet that comprises a substrate layer, a release layer and an image imparting layer that comprises a polymeric layer such as a low density polyethylene layer, an EAA layer, an EVA layer or an MAEA layer. An image receptive layer is a top polymer layer.

With one additional embodiment, an image transfer sheet of the present invention comprises an image imparting layer but is free from an image receptive layer such as an ink receptive layer. Image indicia are imparted, with this embodiment, with techniques such as color copy, laser techniques, toner or by thermo transfer from ribbon wax or from resin.

The LDPE polymer of the image imparting layer melts at a point within a range of 43°–300° C. The LDPE has a melt index (MI) of 60–1,200 SI-g/10 minute.

The EAA has an acrylic acid concentration ranging from 5 to 25% by weight and has an MI of 20 to 1300 g/10 minutes. A preferred EAA embodiment has an acrylic acid concentration of 7 to 20% by weight and an MI range of 20 to 700.

The EVA has a MI within a range of 20 to 2300. The EVA has a vinyl acetate concentration ranging from 10 to 30% by weight.

The present invention further includes a kit for image transfer. The kit comprises an image transfer sheet that is comprised of a substrate layer, a release layer and an image imparting layer made of a polymer such as LDPE, EAA, EVA, or MAEA or mixtures of these polymers that melt at a temperature within a range of 100°–700° C. The LDPE has a melt index of 60–1,200 (SI)-g/minute. The kit also includes a device for imparting an image-imparting medium to the polymer component of the image imparting layer of the image transfer sheet. One kit embodiment additionally includes an image-receiving substrate such as an ink receptive layer that is an element of the image transfer sheet.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

One embodiment of the present invention, an image transfer sheet, illustrated generally at **10** in FIG. **1**, is comprised of a substrate layer **12**, a release layer **14** comprising a silicone coating and a peel layer that together have a thickness of about 3 to 8 mils, also known as an image imparting layer **16**, comprising a polymer component selected from one or more of a low density polyethylene (LDPE), ethylene acrylic acid (EAA), ethylene vinyl acetate (EVA), or methane acrylic ethylene acetate (M/EAA), having a melt index of 20–1200 (SI) g/10 minute and a polymer thickness of 0.7 to 2.3 mils of polymer or (20 g/m^2 to 50 g/m^2 with a melting point range of 40°–450° C.), whereby the release layer **14** is sandwiched between the substrate layer **12** and the peel layer **16** comprising a polymeric material such as LDPE, EAA, EVA or M/EAA.

Another embodiment of the present invention also includes a method for transferring an image from one substrate to another. The method comprises a step of providing an image transfer sheet **10** that is comprised of a substrate or base layer **12**, such as box paper with a base weight of 75 g/m^2 to 162 g/m^2, a release layer **14**, comprising a silicone coating and a peel layer **16** that includes one or more of the polymers LDPE, EAA, EVA, or M/EAA at a thickness of about 1.5 mils and having a melt index, MI, within a range of 60°–1300° C. Next, an image is imparted to the polymer component of the peel layer **16** utilizing a top coating image-imparting material such as ink or toner. The ink or toner may be applied utilizing any conventional method such as an ink jet printer or an ink pen or color copy or a laser printer. The ink may be comprised of any conventional ink formulation. An ink jet coating is preferred.

The image transfer sheet **10** is, in one embodiment, applied to a second substrate, also called the image receiving substrate, so that the polymeric component of the peel layer **16** contacts the second substrate. The second substrate may be comprised of materials such as cloth, paper and other flexible or inflexible materials. Once the image transfer sheet **10** contacts the second substrate, a source of heat, such as an iron or other heat source, is applied to the image transfer sheet **10** and heat is transferred through the peel layer **16**. The peel layer **16** transfers the image to the second substrate. The application of heat to the transfer sheet **10** results in ink or other image-imparting media within the polymeric component of the peel layer being changed in form to particles encapsulated by the polymeric substrate such as the LDPE, EAA, EVA or M/EAA immediately proximal to the ink or toner. The encapsulated ink particles or encapsulated toner particles are then transferred to the second substrate in a mirror image to the ink image or toner image on the polymeric component of the peel layer while the portion of the polymer of the peel layer **16** not contacting the ink or toner and encapsulating the ink or toner is retained on the image transfer sheet **10**.

When image imparting media and techniques such as color copy, laser techniques, toner or thermo transfer from ribbon wax or resin are employed, it is not necessary to apply an image receiving layer to the image transfer sheet.

As used herein, the term "melt index" refers to the value obtained by performing ASTM D-1238 under conditions of temperature, applied load, timing interval and other operative variables which are specified therein for the particular polymer being tested.

It is believed that the addition of ink or toner to the image imparting layer, specifically, to the LDPE or to the EAA, EVA, or E/MAA polymeric component, locally lowers the melting point of the polymeric component material such as LDPE, EAA, EVA, or E/MAA which either contacts the ink or toner or is immediately adjacent to the ink or toner. Thus, an application of heat to the polymeric component of the peel layer **16** results in a change in viscosity of the low density polyethylene or other polymeric material contacted by the ink or toner and immediately adjacent to the ink or toner as compared to the surrounding polymeric media. It is believed that the polymeric component such as LDPE, EAA, EVA or E/MAA polyethylene locally melts with the ink or toner. However, as heat is removed and the area cools, the polymeric component solidifies and encapsulates the ink or toner. The solidification-encapsulation occurs substantially concurrently with transfer of the ink-LDPE or ink-EAA, ink-EVA or ink-E/MAA or other polymer mixture to the receiving substrate.

Because the polymeric component of the peel layer **16** generally has a high melting point, the application of heat, such as from an iron, does not result in melting of this layer or in a significant change in viscosity of the overall peel layer **16**. The change in viscosity is confined to the polymeric component that actually contacts the ink or toner or is immediately adjacent to the ink or toner. As a consequence, a mixture of the polymeric component and ink or toner is transferred to the second substrate sheet as an encapsulate whereby the polymeric component encapsulates the ink or toner. It is believed that the image transfer sheet of the present invention is uniquely capable of both cold peel and hot peel with a very good performance for both types of peels.

One polymeric component, the low density polyethylene ethylene-acrylic acid (EAA) polymeric component, is formed as a product of the co-polymerization of ethylene and acrylic acid forming a polymer with carboxyl groups. The low density EAA polymer is more amorphous than low density polyethylene which causes the EAA to decrease in melting point as compared to LDPE. The carboxyl groups of the acrylic acid group of EAA also provide chemical functional groups for hydrogen bonding.

In one preferred EAA polymer embodiment, acrylic acids are present in a concentration of 5 to 25% by weight of the EAA formulation. The EAA has a melt index ranging from 20 to 1200. The most preferred EAA formulation has an acrylic acid concentration of 10 to 20% by weight. This EAA embodiment has a MI of 60 to 500.

Other polymeric materials that may be used include an ethylene melt with acrylic acid copolymer resin and with a melt flow index ranging from 20–1,500 DS/minute and preferably having a melt flow index of 50–100 DS/minute. This ethylene-acrylic acid polymer melt, known as E/MAA along with ethylene acrylic acid, EAA, ethylene vinyl acetate (EVA) with acetate percentages ranging from 4%–30% and preferably 11%–20% may be used as the polymer in the peel layer **16**. One other preferred E/MAA embodiment has a MI of 60 to 600. One preferred embodiment of E/MAA and EAA includes an acid content within a concentration range of 4 to 25%.

One other polymeric material that may be used is EVA with Vinyl Acetate contents. This polymer has a MI of 100 to 2300. The vinyl acetate contents range from approximately 10 to 30% by weight. In one preferred embodiment, the EVA includes vinyl acetate contents of 10% to 28%, with a melt index within a range of 10 to 600. In one other preferred embodiment, the EVA has an MI within a range of 20 to 600. It is also contemplated that a polyethylene copolymer dispersion may be suitable for use in this layer.

The melt flow indices of these polymer components range from 100 DS/minute to 2,500 DS/minute with a preferable range of 20–700 DS/minute. Each of these polymeric components, in addition to a Surlyninoma resin are usable with or without additives, such as slip additives, UV absorbents, optical brighteners, pigments, antistatics and other additives conventionally added to this type of polymer. All of these polymeric components have softening points within a range of 40°–300° C.

The sheet and method of the present invention accomplish with a simple elegance what other methods and transfer sheets have attempted to accomplish with a great deal of complexity. The sheet and method of the present invention do not require complicated coloring or image-generating systems such as preformed encapsulates. The image transfer sheet and method, furthermore, do not require complicated layer interaction in order to transfer a stable image to an image-receiving substrate. The image transfer sheet of the present invention merely requires a user to impart an image to the polymeric component of the peel or image imparting layer with a material such as ink or toner. In one embodiment, once the image is transferred, the user contacts the peel layer **16** to the second or receiving substrate and applies a source of heat such as an iron. The capacity of the polymeric component of the peel layer to encapsulate an image-imparting media such as ink or toner renders this image transfer sheet exceedingly versatile.

The substrate layer **12** of the image transfer sheet **10** is preferably made of paper but may be made of any flexible or inflexible material ranging from fabric to polypropylene. Specific substrate materials include polyester film, polypropylene, or other film having a matte or glossy finish. In one embodiment, the substrate is a base paper having a weight-to-surface area within a range of 60 g/m^2 to 245 g/m^2 and preferably a range of 80 g/m^2 to 145 g/m^2. The substrate has a thickness that falls within a range of 2.2–12.0 mils and a preferred thickness of 3–8.0 mils, as measured in a Tappi 411 test procedure.

The substrate layer may be coated with clay on one side or both sides. The substrate layer may be resin coated or may be free of coating if the substrate is smooth enough. In one embodiment, overlying the substrate is a silicone coating. The silicone coating has a range of thickness of 0.1 to 2.0 mils with a preferred thickness range of 0.1 to 0.7 mils. The silicone coating has a release in g/inch within a range of 50 to 1100 and a preferred release of 65 to 800 g/inch as measured by a Tappi-410 method. Other release coatings such as fluoro carbon, urethane, or acrylic base polymer may be used.

The silicone-coated layer acts as a release-enhancing layer. It is believed that when heat is applied to the image transfer sheet, thereby encapsulating the image-imparting media such as ink or toner with low density polyethylene, Ethylene Acrylic Acid (EAA), Ethylene Vinyl Acetate (EVA) or Methane Acrylic Ethylene Acrylic (MAEA), or mixtures of these materials, local changes in temperature and fluidity of the low density polyethylene or other polymeric material occurs. These local changes are transmitted into the silicone-coated release layer and result in local, preferential release of the low density polyethylene encapsulates.

This local release facilitates transfer of a "clean" image from the image transfer sheet to the final substrate. By "clean" image is meant an image with a smooth definition.

The silicone-coated release layer is an optional layer that may be eliminated if the image-receiving surface **17** of the peel layer **16** is sufficiently smooth to receive the image. In instances where a silicone-coated release layer is employed, a silicone-coated paper with silicone deposited at 0.32–2.43 g/m^2 is employed. The silicone-coated paper preferably has a release value between 50 g/in. and 700 g/in. The paper may be coated on a backside for curl control or other function, printability or heat stabilities.

A top surface of the silicone may be treated with a corona treatment or chemical treatment prior to application of the polymeric component or on top of the polymer in order to provide better adhesion or to improve washability of the image transferred.

One desirable quality of the polymeric component, LDPE, EVA, EAA or M/EAA, is that it has a capacity to coat any fibers or other types of discontinuities on the image-receiving substrate and to solidify about these fibers or discontinuities. This coating and solidification on fibers or any other type of discontinuity in the receiving substrate aids in imparting a permanency to the final, transferred image. Because the image-generated media, such as ink or toner, is actually encapsulated in the low density polyethylene or other polymeric component material, the image transferred along with the LDPE, EVA, EAA or M/EAA, is a permanent image that cannot be washed away or removed with conventional physical or chemical perturbations such as machine washing. The polymeric materials LDPE, EVA, EAA, or M/EAA are relatively inert to chemical perturbations. In one embodiment, the LDPE, EVA, EAA, or M/EAA is applied to either the substrate or the release layer **14** in a thickness within a range of 0.5 mils to 2.8 mils or 10 g/m^2 to 55 g/m^2 and preferably 22 g/m^2 to 48 g/m^2.

Overlying the polymeric component containing peel layer **16** is a prime layer GAT with polyethylene dispersion or an EAA or EVA dispersion. This layer has a high melting index within a range of 200–2,000. The EAA emulsion dispersion has an MI of 200–2000 and has an acrylic acid concentration of 7%–25% by weight. The EVA dispersion has an MI of 200–2500 and an acetate or other acrylic polymer concentration of 7%–33% by weight.

A fifth layer is an ink jet coating receptor layer having a thickness of 3 g/m^2 to 30 g/m^2. Overlying the ink jet coating receptor layer is an ink jet top coating layer having a thickness of 4 g/m^2–30 g/m^2. In one embodiment, the ink jet coating receptor layer and ink jet top coating layer are combined to create a single layer having a heavier coat weight.

This layer is not required when image imparting techniques such as color copy, laser, loner, or thermo transfer from ribbon wax or resin are employed.

In one embodiment, the image transfer sheet of the present invention is made by applying a low density polyethylene, or a low density polyethylene ethylene acrylic acid or an ethylene vinyl acetate (10%–28%) of vinyl acetate to the substrate utilizing a process such as extrusion, hot melt, slot die, or a "roll on" process or other similar process.

The low density polyethylene preferably has a melt index within a range of 20–1,200 g/10 minutes and most preferably a melt index of 100–700-g/minute. An acceptable melt flow rate measured at 125 degrees Centigrade and 325 grams falls within a range of 7–30 g/10 min. with a preferred range of 8–20 g/10 min. as measured by ASTM Test Method D-1238. An Equivalent Melt Index, EMI, which is equal to 66.8×(Melt Flow Rate at 125 C, 325 grams) 0.83, may acceptably range from 30–2000 g/10 min. and preferably ranges from 200–800 g/10 min. The Melting Point, Tm, ranges from 43 to 250 degrees Centigrade with a preferred range of 65 to 150 degrees Centigrade as measured in ASTM Test Method D-3417. The Vicat Softening Point of the LDPE ranges from 43 to 150 degrees Centigrade as measured by ASTM Test Method D-1525.

The ethylene vinyl acetate (EVA) has a melt index of 200–2500 dg/minute with a preferred index range of 200 to 1200 dg/min. The Ring and Ball Softening Point ranges from 67 to 200 degrees C., with a preferred range of 76 to 150 degrees C. The percent vinyl acetate in the EVA is within a range of 5 to 33% and preferably within a range of 10–33%. The metoacrylic acid or ethylene acrylic acid also known as Nucryl™ has a concentration of about 4%–20% acrylic acid and a melt index within a range of 50–1,300-g/minute. The preferable range is 200–600-g/minute.

The EAA/EMAA has a Melt Index of 20–1300 dg/min. with a preferred range of 60–700 dg/min. as measured in ASTM Test Method D-1238. The Vicat Softening Point ranges from 43–225 degrees Centigrade with a preferred range of 43–150 degrees Centigrade as measured by ASTM Test 43–150 degrees Centigrade. The EAA/EMAA has a percent acrylic acid concentration within a range of 5–25 percent with a preferred range of 7–22 percent by weight. The Melt Flow Rate ranges from 7–90 g/10 min. with a preferred range of 7–65 g/10 min. as measured by ASTM test method D-1238.

Twenty-eight g/m^2 to 50 g/m^2 are applied to a substrate. The application thickness of one of the LDPE, EAA, EVA or Nucryl™ is 1 to 2 mils in thickness. The most preferred range of thickness of 1.0–2.2 mils.

In one embodiment, the polymeric components of LDPE, EAA, EVA or Nucryl™ is applied to a silicone-release coated paper. The silicone-release coating is applied to paper or film to basis WT 80 g/m^2 an application quantity of 80 g/m^2 to 200 g/m^2 and preferably at a rate of 95 g/m^2 to 170 g/m^2.

Application of the polymeric component to the substrate, such as release coated paper, may be by extrusion, roll coater, any coating process, slot-die or hot melt extrusion. Other acceptable methods of application include an air knife or rod blade application. The polymeric component may be prime coated with a corona treatment or chemical treatment with acrylic acid emulsion having a melt index of 300–2,000-g/min., or an EVA emulsion, chemical primer or corona treatment or may be eliminated if chemical treatment for adhesion was applied. A top coat may be applied over the polymeric component. The final application is an ink jet coating of two or three passes to deposit 4 g/m^2 to 30 g/m^2 depending on particular printing applications.

One embodiment of the image transfer sheet is described in Table 1 with respect to layer identity, interlayer relationship and rate of application of each layer.

TABLE 1

Layer Type	Applications in G/M^2	
Base paper	70-160	g/m2 layer barrier coating 3-10 (applied on one or both sides of the base paper)
Silicone coating (or other release coating)	0.4-2	lbs/300 SF
Corona treatment (may or may not be necessary)		
Film or peel layer	20-50	
Corona treatment (or other chemical)	1-5	
Ink jet coating	4-35	(the ink jet coating could be applied in one, two, three, or additional passes)

The film layer may be applied as a cold peel or as a hot peel.

Presented herein is one example of one preferred embodiment of the image transfer sheet of the present invention. This example is presented to illustrate particular layers and particular specification for the layers and is not intended to limit the scope of the present invention.

EXAMPLE

In one embodiment, the image transfer sheet included a first substrate layer of base paper having a basis weight of 65 g/m^2 to 145 g/m^2 and preferably falling within a range of 97 g/m^2 to 138 g/m^2. While paper is described, it is contemplated that materials such as polyester film, polypropylene or polyethylene or other film of 142–1,000 gauge matte or glossy finish may be employed. In instances where paper is used, the paper may be clay coated on one side, or both sides, or polymer coated.

Overlaying the base substrate paper layer was a release layer comprising silicone. Other acceptable release coatings include fluorocarbon or other acrylic, urethane release coatings and so on. The release layer had a release value ranging from 50 g/in. to 2,000 g/in. and preferably a range of 80 g/in. to 500 g/in. The release layer may be omitted if the base paper has a surface of sufficient smoothness.

A third layer which is a peel layer of the image transfer sheet includes a low density polyethylene or other polymer polyethylene applied at a thickness of 0.5 mils to 2.8 mils or 10 g/m^2 to 55 g/m^2 and preferably 22 g/m^2 to 48 g/m^2. Other acceptable materials for use in the third layer include acrylic acid of 5%–22% ethylene vinyl acetate, 10%–28% (EVA) with a melt index ranging from 30–2,000. In one preferred embodiment, the melt index was 60–500. In addition to the materials mentioned, the third layer may also be comprised of a polyethylene copolymer dispersion.

The LDPE or EVA or polyethylene copolymer dispersion is primed with GAT with a high melt index ranging from 200–2,000. A preferred range is 200–2,000. It is contemplated that this primer layer is optional.

A fifth layer is a first layer of ink jet coating receptor laid down in a concentration of 3 g/m^2 to 30 g/m^2.

A sixth layer which is a third ink jet top coating is laid down at a concentration of 4 g/m^2 to 15 g/m^2. It is possible that the ink jet top coating could be laid down in a single pass in order to make a single layer with a heavier coat weight.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

What is claimed is:

1. An image transfer sheet [capable of transferring an ink image to an image receiving material], comprising:

a *removable* substrate [layer] *comprising at least one of a base paper or film*;

[a release layer;]

a peel member comprising a polymer [layer] *component* having a melt index within a range of *about* 20 [to 1200] grams per 10 minutes *to about 2300 grams per 10 minutes, the polymer component including a portion configured to carry image indicia to be transferred;*

[wherein the release layer is positioned between the substrate layer and the polymer layer; and ink from an ink jet printer or an ink pen or a laser printer that forms an image on and in the polymer layer wherein the ink and polymer contacting the ink when the ink is applied to the polymer are transferred to the image receiving material without transfer of the entire polymer layer]

a release-enhancing coating positioned such that a first coating surface is abutting the removable substrate and a second coating surface is abutting the peel member; and

an image-receptive member overlaying the peel member and configured to receive image-imparting media, forming the image indicia, from a copying or printing process, the image-receptive member including an ink jet coating receptor layer having a thickness ranging from about 3 grams/square meter to about 30 grams/square meter, and an ink jet top coating layer overlaying the ink jet coating receptor layer and having a thickness ranging from about 4 grams/square meter to about 30 grams/square meter;

wherein the peel member is removable from the release-enhancing coating when the peel member is in a heated state and when the peel member is in a cooled or ambient state, and

wherein the removable substrate is configured to transfer external heat, when applied, to one or both of the peel member or the image-receptive member sufficient to encapsulate the image indicia on an image-receiving substrate during an image transfer process.

2. The image transfer sheet of claim **1** wherein the polymer [layer melts at a] *component portion includes a melting* temperature within a range of [60–700 C] *about 43° C. to about 700° C.*

[**3**. The sheet of claim **1** wherein the release layer is comprised of a silicone coating.]

4. The *image transfer* sheet of claim **1**, wherein the [release layer comprises a silicone coating and a base paper, the layer having] *release-enhancing coating has* a thickness [of approximately 3.0–8.0] *ranging from about 0.1 mils to about 2* mils.

5. The *image transfer* sheet of claim [**1**] *28,* wherein the polymer [layer] *component portion* has a thickness [within a range of] *ranging from* about [1.0 to 2.2] *0.5 mils to about 2.8* mils.

6. The image transfer sheet of claim [**2** and further including an image-imparting medium encapsulated within the polymer] *28, wherein the polymer component portion is configured to encapsulate image-imparting media, of the image indica, when heat is transferred through the peel member.*

[**7**. The image transfer sheet of claim **1** wherein the polymer layer comprises a low density polyethylene layer.]

[**8**. The image transfer sheet of claim **1** wherein the polymer layer comprises one or more of a low density polyethylene, ethylene vinyl acetate layer, or ethylene acrylic acid.]

9. The image transfer sheet of claim [**1**] *15,* wherein the polymer [comprises a vinyl acetate fraction or an acrylic acid fraction] *component portion includes ethylene vinyl acetate having a vinyl acetate concentration within a range of about 10% to about 30% by weight, or ethylene acrylic acid having an acrylic acid concentration within a range of about 5% to about 25% by weight.*

[**10**. An image transfer system comprising:

an article effective for receiving and retaining an image; and

an image transfer sheet for transferring the image to the article without application of heat, the image transfer sheet comprising:

a substrate layer;

a release layer;

a polymer layer comprising one or more of a low density polyethylene, ethylene vinyl acetate, and ethylene acrylic acid,

wherein the release layer is positioned between the substrate layer and the polymer layer; and

ink from an ink jet printer or an ink pen or a laser printer that forms the image on and in the polymer layer wherein the image is transferred and adhered to the article without transfer of the entire polymer layer.]

11. The image transfer sheet of claim 6, wherein the image-imparting media includes at least one of toner or ink.

12. The image transfer sheet of claim 6, wherein the polymer component portion is configured such that one or more portions of the polymer component portion contacting or adjacent the image-imparting media is configured to change viscosity when heat is transferred through the peel member.

13. An image transfer sheet, comprising:

a silicone-coated removable substrate, the removable substrate including a base paper or film and having a substrate surface abutting a silicone coating, the silicone coating having a thickness less than about 2 mils; and

a peel member overlaying, and peelable from, the silicone coating, the peel member including a polymer component portion configured to carry image indicia to be transferred,

wherein the removable substrate is configured to transfer external heat, when applied, to the peel member sufficient to encapsulate the image indicia on an image-receiving substrate during an image transfer process.

14. The image transfer sheet of claim 13, wherein the polymer component portion includes at least one of low density polyethylene, ethylene vinyl acetate, a copolymer of ethylene and acrylic acid, or ethylene acrylic acid.

15. The image transfer sheet of claim 13, wherein the polymer component portion includes a melt flow index within a range of about 100 DS/minute to about 2,500 DS/minute.

16. The image transfer sheet of claim 13, wherein a surface of the silicone coating abutting the peel member is one or both of corona treated or chemically treated prior to be overlaid with the peel member.

17. The image transfer sheet of claim 13, wherein the removable substrate, the silicone coating, and the peel member have a combined thickness ranging from about 3 mils to about 8 mils.

18. The image transfer sheet of claim 13, wherein the silicone coating has a release value less than about 1100 grams/inch.

19. The image transfer sheet of claim 18, wherein the silicone coating has a release value ranging from about 50 grams/inch to about 700 grams/inch.

20. A kit comprising:

the image transfer sheet of claim 13; and

instructions for using the image transfer sheet.

21. A kit comprising:

the image transfer sheet of claim 13;

instructions for using the image transfer sheet; and

an image-receiving substrate configured to receive and retain image indicia transferred from the image transfer sheet.

22. The kit of claim 21, wherein the image-receiving substrate is a light-colored fabric.

23. The image transfer sheet of claim 13, comprising an image-receptive member overlaying the peel member, the image-receptive member configured to receive image-imparting media, forming the image indicia, from a copying or printing process.

24. A sheet, comprising:

a substrate member comprising at least one of a base paper or film and having a basis weight less than about 245 grams/square meter; and

a release-enhancing coating overlaying and abutting a surface of the substrate member, the release-enhancing coating having a release value less than about 2,000 grams/inch;

a peel member overlaying the release-enhancing coating and having a portion configured to carry image indicia to be transferred, the peel member including at least one of low density polyethylene, ethylene vinyl acetate, a copolymer of ethylene and acrylic acid, or ethylene acrylic acid;

a primer layer overlaying the peel member, the primer layer having a melt index ranging from about 200 grams per 10 minutes to about 2,000 grams per 10 minutes;

an ink jet coating receptor layer overlaying the primer layer, the ink jet coating receptor layer having a thickness ranging from about 3 grams/square meter to about 30 grams/square meter; and

an ink jet top coating layer overlaying the ink jet coating receptor layer having a thickness ranging from about 4 grams/square meter to about 30 grams/square meter,

wherein the substrate member is configured to transfer external heat, when applied, to one or more of the peel member, the primer layer, the ink jet coating layer or the ink jet top coating layer sufficient to encapsulate the image indicia on an image-receiving substrate during an image transfer process.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : RE42,541 E
APPLICATION NO. : 11/054717
DATED : July 12, 2011
INVENTOR(S) : Jody A. Dalvey et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 9, line 48, in Claim 2, delete "claim 1" and insert -- claim [1] *28*, --, therefor.

Signed and Sealed this
Nineteenth Day of March, 2013

Teresa Stanek Rea
Acting Director of the United States Patent and Trademark Office