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(71) Applicant:
ARKWRIGHT Incorporated
Fiskeville, Rhode Island 02823-0139 (US)

(72) Inventors:
• **Wang, Yongzhong**
West Warwick, Rhode Island 02893 (US)
• **Song, Jiancheng**
Coventry, Rhode Island 02816 (US)

(74) Representative: **Merkle, Gebhard**
TER MEER STEINMEISTER & PARTNER GbR,
Patentanwälte,
Mauerkircherstrasse 45
81679 München (DE)

(54) **A transparent recording sheet having an image-receptive coating, an anti-static coating, and a removable opaque anti-static adhesive strip**

(57) This invention relates to a transparent recording sheet used in copiers and printers. The transparent recording sheet comprises a transparent film substrate and a removable opaque anti-static adhesive-film strip. An anti-static coating is applied to one surface of the film substrate and to one surface of the adhesive-film strip. The recording sheets of this invention can be fed into copiers and printers without causing jamming and feeding problems.

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of United States provisional application 60/081,464 having a filing date of April 13, 1998.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] This invention relates to a transparent recording sheet used in copiers and printers, and more particularly to a transparent recording sheet bearing an image-receptive coating, an anti-static coating, and a removable opaque anti-static adhesive-film strip.

Brief Description of the Related Art

[0003] Transparent recording sheets bearing images, particularly colored images, are commonly used as overhead transparencies in presentations with overhead projectors. The recording sheets are first imaged in printers or copiers having optical sensors that detect only opaque materials; thus, the transparent recording sheet must be made partially or completely opaque before imaging can occur. The recording sheet typically has an ink or toner-receptive coating on its recording surface for receiving the image, while its non-recording surface can be rendered opaque by various methods.

[0004] One commonly used method is to attach a removable paper backing to the transparent recording sheet by means of a small amount of pressure-sensitive adhesive on one edge of the sheet. After the recording sheet is imaged, the paper backing is removed. However, one problem with this system is that the paper backing, with a typical thickness of 75 μm to 100 μm , insulates the recording sheet from close contact with a copier's heated fuser. This may result in insufficient heating of the toner onto the recording sheet and poor image quality.

[0005] A second method involves applying an opaque ink stripe along one edge of the transparent recording sheet as disclosed in Takeuchi, U.S. Patent 5,126,762. The opaque ink stripe allows printers and copiers to detect incoming recording sheets, and overcomes the problem of insufficient heating of the toner onto the recording sheet. But, the ink stripes are not removable after imaging and leave visible marks during overhead presentations.

[0006] A third method employs a removable adhesive-paper strip on one edge of the transparent recording sheet. The adhesive-paper strip is peeled-off the recording sheet after imaging, thus allowing the image to be fully viewed during overhead presentations. However, the adhesive-paper strip typically has a thickness of 75 μm to 100 μm which may cause recording sheets

to jam in printers and copiers, particularly when such sheets are fed with sheets not having adhesive-paper strips. The edge portion of a recording sheet having an adhesive-paper strip is substantially thicker than the edge portion of a sheet not having an adhesive-paper strip. When a large number of different recording sheets are stacked in a feeding tray, the stack has a slope-like shape due to the difference in thickness between edges of the sheets. This large sloping stack may cause sheet feeding problems. Thus, in order to ensure reliable feeding, the number of sheets stacked at one time in a feeding tray is typically limited to about 50-100 sheets.

[0007] A fourth method employs a thin pressure-sensitive adhesive opaque plastic stripe on the transparent recording sheets as disclosed in published European Patent Application EP 0 695 973 A1. The removable opaque plastic stripe may be made by applying a white coating onto one surface of a film, slitting the film into thin plastics stripes, and applying an adhesive coating onto the other surface of the plastic stripe. The adhesive plastic stripe is much thinner than an adhesive-paper stripe.

[0008] Transparent recording sheets bearing adhesive-film strips that have not been rendered anti-static can be used in black and white copiers. However, such recording sheets tend to jam in color copiers because they are exposed to a static environment for a longer period of time in a color copier than a black and white copier. It would be desirable to have transparent recording sheets bearing adhesive-film strips that could be effectively fed into color copiers and printers, as well as black and white copiers and printers, without causing jamming problems. The present invention provides such transparent recording sheets.

SUMMARY OF THE INVENTION

[0009] The present invention provides a transparent recording sheet comprising a transparent film substrate and a removable opaque anti-static adhesive-film strip. The film substrate has an image-receptive coating on one of its surfaces and an anti-static coating on its other surface. The adhesive-film strip has an adhesive coating on one of its surfaces and an anti-static coating on its opposite surface. The adhesive-film strip is adhered to the surface of the transparent film substrate bearing the anti-static coating.

[0010] The surface of the transparent film substrate bearing the anti-static coating may also have an image receptive-coating. Preferably, the transparent film substrate and adhesive-film strips are polyethylene terephthalate films. The thickness of the transparent film substrate is typically in the range of about 80 μm to about 200 μm , and the thickness of the adhesive-film strip is typically in the range of about 8 μm to about 75 μm . The width of the adhesive-film strip is typically in the range of about 2 to about 15 mm. The image-receptive coating is preferably an ink-receptive or toner-receptive

coating.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The present invention provides a transparent recording sheet comprising a transparent film substrate and a removable opaque anti-static adhesive-film strip. The transparent film substrate for the recording sheet of this invention is made of a polymeric material having suitable physical characteristics so as to be resistant to tearing and heat damage from copiers and printers. Suitable polymeric materials generally include thermoplastic polymers, such as polyester, particularly polyethylene terephthalate (PET), poly(methyl methacrylate), cellulose acetate, poly(vinyl chloride), poly(vinyl acetate), polyvinylidene fluoride, polyamides and polyimides. Preferably a PET film with a thickness in the range of about 80µm to about 200µm is used.

[0012] The transparent film substrates have "front" and "back" surfaces. In one embodiment of the present invention, the "front" surface is coated with an ink or toner-receptive coating (collectively referred to herein as an image-receptive coating) for recording images. The front surface is referred to as the recording surface, while the "back surface" is coated with an anti-static coating and is referred to as the non-recording surface. Such a recording sheet, where the base film is coated with an image-receptive coating only on its front surface, may be referred to as an "asymmetric" recording sheet.

[0013] In another embodiment of this invention, the back surface of the film substrate is also coated with an image-receptive coating capable of recording images. Such a recording sheet having two recording surfaces, where the base film is coated with an image-receptive coating on its front and back surfaces, may be referred to as a "symmetric" recording sheet.

[0014] Conventional image-receptive coating compositions for recording images can be applied to the front and back surfaces of the transparent film substrate. An ink-receptive coating may contain a water-soluble component such as poly(vinyl alcohol), poly(vinyl pyrrolidone), poly(2-ethyl-2-oxazoline), polyacrylamide, gelatins, poly(vinyl acetate), poly(ethylene glycol), poly(ethylene oxide), cellulose esters, proteins, alginates, poly(acrylic acid), water-soluble gums, and mixtures thereof. A toner-receptive coating may contain a thermoplastic resin such as, for example, resins containing poly(vinyl chloride), polyvinylidene chloride, poly(vinyl acetate), poly(methyl methacrylate), polychloroprene, a hydroxyl modified copolymer of vinyl chloride and vinyl acetate, acrylic copolymers, chlorinated rubbers, and mixtures thereof.

[0015] The anti-static coating composition that is applied to the back surface (i.e., second surface) of the transparent film substrate may contain conventional anti-static agents. Suitable anti-static agents include, for example, alkali metal and ammonium salts of poly(sty-

rene sulfonic acid), sulfonated styrene/maleic anhydride copolymer, poly(acrylic acid), poly(methacrylic acid), poly(vinyl phosphate) and free acids thereof, copolymers of dimethyl allyl ammonium chloride and diacetone acrylamide, quaternary acrylics, copolymers of dimethyl diallyl ammonium chloride and N-methylacrylamide, poly(dimethyl diallyl) ammonium chloride, quaternary cellulose acetate, and other conductive materials known in the art.

[0016] The removable opaque anti-static adhesive-film strip of this invention comprises an opaque plastic film having two surfaces. A pressure-sensitive adhesive composition is coated on one surface of the plastic film. An anti-static composition is coated on the opposite surface (i.e., second surface) of the plastic film. The adhesive-film strip is adhered to the surface of the film substrate being the anti-static coating by means of the pressure-sensitive adhesive composition. The surface of the film strip comprising the anti-static coating is exposed, i.e., it faces upwards.

[0017] Suitable polymeric materials that can be used to make the adhesive-film strip include, for example, polyolefins such as polyethylene and polybutylene, polystyrene, polyesters such as polyethylene terephthalate (PET), poly(methyl methacrylate), cellulose acetate, poly(vinyl chloride), polyvinylidene fluoride, polyamides and polyimides. PET films are preferred. The thickness of the polymeric film used to make the adhesive-film strip is typically in the range of about 8 µm to about 50 µm, preferably about 25 µm.

[0018] The adhesive-film strip should have an opacity of at least 70% so that the recording sheets may be easily detected by optical sensors in copiers and printers. The films can be rendered opaque by techniques known in the art. Such techniques may involve coating the film with a pigmented composition containing pigments such as titanium dioxide, calcium carbonate, and the like. The adhesive-film strip should have sufficient tensile strength to resist being torn when the recording sheets are fed into copiers and printers. Further, the adhesive-film strip should have sufficient heat-resistance so that it can resist heat damage and shrinkage during the fusing process in color copiers, where temperatures as high as 160°C may occur.

[0019] The anti-static composition used to coat one surface of the adhesive-film strip contains conventional anti-static agents such as the agents described above.

[0020] The pressure-sensitive adhesive composition used to coat the other surface of the adhesive-film strip contains conventional water-based or solvent-based adhesives such as acrylic, polyester, or rubber adhesives having high sheer and low peel strengths. A cross-linking agent can be added to the adhesive composition to further increase its sheer strength and decrease its peel strength. The adhesive layer should have a thickness in the range of about 2 µm to about 25 µm, preferably from 5 µm to 15 µm. Accordingly, the total thickness of the adhesive-film strip, i.e., film and adhesive layer, is

typically in the range of about 10µm to about 75 µm, preferably from 30µm to 50µm.

[0021] The adhesive strip is applied to the non-recording surface of an asymmetric recording sheet or to one of the two recording surfaces of a symmetric recording sheet. The transparent recording sheets have four edges and are usually A4 or A size. The former has a long edge of 297 mm and a short edge of 210 mm. The latter has a long edge of 279 mm and a short edge of 216 mm. The adhesive-film strip may be applied to either the long or short edge of the recording sheet. The recording sheet can be converted into other rectangular sizes with the adhesive strip applied to either "side" (i.e., on a long edge) or on the "top" or "bottom" (i.e., on a short edge). The width of the adhesive-film strip typically varies from about 3 mm to about 20 mm, with 5 mm and 9.5 mm strips preferred. It is important that the adhesive strip strongly adhere to the surface of the recording sheet for long periods of time. At the same time, the adhesive strip must be removable from the recording sheet after a specified period of

[0022] In the present invention, it is important that an anti-static coating be applied to a surface of the transparent film substrate and to the exposed surface of the adhesive-film strip. The surface of the recording sheet bearing the anti-static coating and adhesive-film strip should have a surface resistivity in the range of about 1×10^7 ohms/square to about 1×10^{13} ohms/square. As demonstrated below in the Examples, the recording sheets of this invention can be rapidly fed into copiers and printers without causing jamming and feeding problems.

[0023] The present invention is further illustrated by the following examples, but these examples should not be construed as limiting the scope of the invention.

EXAMPLES

Example 1

[0024] A transparent recording film comprising a PET base film having an image-receptive coating on its front surface and an anti-static coating on its back surface was constructed. The image-receptive coating composition had the following formulation.

Methyl propyl ketone	82.76 parts
Epon 1004F ⁽¹⁾	15.00 parts
Pergut S 20 ⁽²⁾	0.30 parts
Soken MR10G ⁽³⁾	0.10 parts
Shamrock SST2SP5 ⁽⁴⁾	0.05 parts
Cyaguard 609 ⁽⁵⁾	1.75 parts
BYK 306 ⁽⁶⁾	0.04 parts

(1) Epoxy resin available from Shell Chemical Company.

(2) Chlorinated rubber available from Bayer.

(3) Polymethylmethacrylate pigments available from Esprit Chemical Company.

(4) Polytetrafluoroethylene pigment available from Shamrock Chemical Company.

(5) Quaternary salt type cationic anti-static available from Cytec Inc.

(6) Polyether modified polydimethylsiloxane wetting additive available from BYK Chemie.

[0025] Epon 1004F was added to a drum containing methyl propyl ketone solvent and mixed for 30 minutes. The chlorinated rubber (Pergut S-20), polymethylmethacrylate and polytetrafluoroethylene pigments were then added to the drum under agitation and mixed for 30 minutes. The quaternary salt anti-static agent (Cyaguard 609) and the wetting aid (BYK 306) were then added to the drum with agitation. The resulting coating solution was applied to the front surface of a polyethylene terephthalate film (available from ICI America, Inc.). The coating was dried at 120°C for 1.5 minutes.

[0026] The anti-static coating composition had the following formulation.

Water	83.63 parts
Dowanol PnB solvent ⁽¹⁾	1.0 parts
Soken MR10G ⁽²⁾	0.10 parts
Neptune SST2SP5 ⁽³⁾	0.05 parts
Rhoplex AC-73T ⁽⁴⁾	15.0 parts
Cyaguard 609 ⁽⁵⁾	0.20 parts
BYK 348 ⁽⁶⁾	0.02 parts

(1) Propylene glycol n-butyl ether available from Dow Chemical Company.

(2) Polymethylmethacrylate pigments available from Esprit Chemical Company.

(3) Polytetrafluoroethylene pigment available from Shamrock Chemical Company.

(4) Acrylic emulsion available from the Rohm and Haas Company.

(5) Quaternary salt type cationic anti-static agent available from Cytec Inc.

(6) Polyether modified polydimethylsiloxane wetting additive available from BYK Chemie.

[0027] Propylene glycol n-butyl ether was added to a drum containing water and mixed for 10 minutes. The polymethylmethacrylate and polytetrafluoroethylene pigments were then added to the drum under agitation and mixed for 30 minutes. Rhoplex AC-73T emulsion was then added under agitation. The quaternary salt anti-static agent (Cyaguard 609) and the wetting aid (BYK 306) were then added to the drum with agitation. The resulting anti-static coating was applied to the back surface of the polyethylene terephthalate film. The coating was dried at 120°C for 1.5 minutes.

Example 2

[0028] A removable opaque adhesive-film strip comprising an opaque PET film having an anti-static coating on one surface and an adhesive coating on its opposite surface was constructed. The base plastic film was an opaque PET film (0.92 mil, 339 film, available from ICI America, Inc.). 54.4 g of water, 0.6 g of Versa TL 502 (National Starch & Chemicals, Inc.), 10.0 g of Micral 1440 (J. M. Huber Corp.) and 35 g of Pliolite WR-D (Goodyear Chemicals, Inc.) were mixed together for 30 minutes to form the anti-static coating composition. The anti-static composition was coated onto the PET film with a #6 Mayer rod and dried in an oven at 275 °F for 18 seconds. The resistivity of the coating was measured at 1×10^{10} ohms/square.

[0029] The adhesive coating had the following weight

percentage composition: 17.0% water, 81.5% Acronal 3432 (BASF Corp.) and 1.5% Xama-7 (BFGoodrich Co.). The adhesive composition was coated on the second surface of the PET film, i.e., surface opposite to the surface comprising the anti-static coating, using a #24 Mayer rod. The adhesive coating was dried in an oven at 275 °F for 30 seconds.

[0030] The PET film was slit into 10 mm and 20 mm wide adhesive strips which were laminated onto the transparent recording film described above in **Example 1**. The recording film was then converted into A4 size sheets bearing a 5 mm or 9.5 mm wide adhesive-film strip. These sheets were imaged in Xerox 5760 and Canon CLC 700 color copiers as described below in Examples 5-7.

Example 3

[0031] A removable opaque adhesive-film strip was made in the same manner as described in **Example 2**, except that the adhesive coating had the following weight percentage composition: 15.0% water, 1.5% Xama-7, 81.5% Acronal 3432 and 2% Gel-Tac 201C (Advanced Polymers International, Inc.).

Example 4 (Comparative)

[0032] The transparent recording film in **Example 1** was converted into A4 size sheets, and an untreated adhesive-film strip (i.e., strip not having an anti-static coating) (9.5 mm width), available from Coating Science Inc., was adhered to the side edge of each sheet. The A4 size transparent sheets were placed in a by-pass feeding tray of a Xerox 5760 copier such that the surfaces having the adhesive strips were face-down. In several imaging (copying) tests, the second or third incoming recording sheet would jam in the copier, causing sheet feeding problems.

Example 5

[0033] The transparent recording film in **Example 1** was converted into A4 size sheets, and the adhesive-film strip described in **Example 2** (9.5 mm width) having an anti-static coating was adhered to the side edge of each sheet. The A4 size transparent sheets were placed in a by-pass feeding tray of a Xerox 5760 copier such that the surfaces having the adhesive strips were face-down. Fifty (50) recording sheets were imaged on the Xerox 5760 copier without any jamming or feeding problems.

Example 6

[0034] The transparent recording film in **Example 1** was converted into A4 size sheets, and the adhesive-film strip described in **Example 2** (9.5 mm width) having an anti-static coating was adhered to the side edge of

each sheet. The A4 size transparent sheets were placed in a by-pass feeding tray of a Canon CLC 700 copier such that the surfaces having the adhesive strips were face-down. Fifty (50) recording sheets were imaged on the Canon CLC 700 copier without any jamming or feeding problems.

Example 7

[0035] The transparent recording film in **Example 1** was converted into A4 size sheets, and the adhesive-film strip described in **Example 2** (5 mm width) having an anti-static coating was adhered to the side edge of each sheet. The A4 size transparent sheets were placed in a by-pass feeding tray of a Canon CLC 700 copier such that the surfaces having the adhesive strips were face-down. Fifty (50) recording sheets were imaged on the Canon CLC 700 copier without any jamming or feeding problems.

Example 8

[0036] The transparent recording film in **Example 1** was converted into A4 size sheets, and the adhesive-film strip described in **Example 3** (9.5 mm width) having an anti-static coating was adhered to the side edge of each sheet. The A4 size transparent sheets were placed in a by-pass feeding tray of a Canon CLC 700 copier such that the surfaces having the adhesive strips were face-down. Fifty (50) recording sheets were imaged on the Canon CLC 700 copier without any jamming or feeding problems.

Example 9

[0037] The transparent recording film in **Example 1** was converted into A4 size sheets, and the adhesive-film strip described in **Example 3** (9.5 mm width) having an anti-static coating was adhered to the side edge of each sheet. The A4 size transparent sheets were placed in a by-pass feeding tray of a Xerox 5760 copier such that the surfaces having the adhesive strips were face-down. Fifty (50) recording sheets were imaged on the Xerox 5760 copier without any jamming or feeding problems.

Example 10

[0038] The transparent recording film in **Example 1** was converted into A4 size sheets, and the adhesive-film strip described in **Example 3** (5 mm width) having an anti-static coating was adhered to the side edge of each sheet. The A4 size transparent sheets were placed in a by-pass feeding tray of a Canon CLC 700 copier such that the surfaces having the adhesive strips were face-down. Fifty (50) recording sheets were imaged on the Canon CLC 700 copier without any jamming or feeding problems.

Example 11

[0039] An ink jet transparent recording film (348 film available from Arkwright, Inc.) was converted into A size sheets and the adhesive-film strip described in **Example 3** (9.5 mm width) having an anti-static coating was adhered to the top edge of each sheet. The 348 film had an image-receptive coating on its front surface and an anti-static coating on its back surface. The A size sheets were placed in the loading trays of HP Deskjet 680, HP Deskjet 1200C and HP Deskjet 1600C printers such that the surfaces having the adhesive strips were face-up. Fifty (50) sheets of the recording sheets were imaged on these machines without jamming or feeding problems.

Example 12

[0040] An ink jet transparent recording film (348 film available from Arkwright, Inc.) was converted into A size sheets and the adhesive-film strip described in **Example 2** (9.5 mm width) having an anti-static coating was adhered to the top edge of each sheet. The 348 film had an image-receptive coating on its front surface and an anti-static coating on its back surface. The A size sheets were placed in the loading trays of HP Deskjet 680, HP Deskjet 1200C and HP Deskjet 1600C printers such that the surfaces having the adhesive strips were face-up. Fifty (50) sheets of the recording sheets were imaged on these machines without jamming or feeding problems.

Claims

1. A transparent recording sheet comprising:

- a) a transparent film substrate having an image-receptive coating on one surface and an anti-static coating on a second surface, and
- b) a removable opaque adhesive-film strip having an adhesive coating on one surface and an anti-static coating on a second surface, wherein said adhesive-film strip is adhered to the second surface of the transparent film substrate.

2. The transparent recording sheet of claim 1, wherein the second surface of the transparent film substrate further comprises an image-receptive coating.

3. The transparent recording sheet of claim 1, wherein the transparent film substrate and adhesive-film strips are polyethylene terephthalate films.

4. The transparent recording sheet of claim 1, wherein the transparent film substrate has a thickness in the range of about 80 μm to about 200 μm .

6. The transparent recording sheet of claim 1,
wherein the adhesive-film strip has a thickness in
the range of about 8 μm to about 75 μm .

7. The transparent recording sheet of claim 1, ⁵
wherein the adhesive-film strip has a width in the
range of about 2 to about 15 mm.

8. The transparent recording sheet of claim 1,
wherein the image-receptive coating is an ink- ¹⁰
receptive coating.

9. The transparent recording sheet of claim 1,
wherein the image-receptive coating is a toner-
receptive coating. ¹⁵

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