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D-40593 Düsseldorf (DE)(54) **Foundation for use in thermal transfer ink sheet and thermal transfer ink sheet using the same.**

(57) A thermal transfer ink sheet having a thin foundation and a thin ink layer, which includes a film made of a polyester resin having an average molecular weight of 12×10^3 to 30×10^3 , the film having a thickness of 1.5 to 3.0 μm and a heat shrinkage ratio of 3 % or lower in the longitudinal direction and 2 % or lower in the transverse direction, and a heat-meltable ink applied on one side of the film in an amount of 1.5 to 2.5 g/m².

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The present invention relates to a foundation for use in thermal transfer ink sheets and to a thermal transfer ink sheet using the same.

Hitherto, there have widely been used thermal transfer ink sheets of the type wherein a heat-meltable ink is applied on one side of a foundation such as a polyethylene terephthalate film.

It has recently been desired that such thermal transfer ink sheets be made thin so as to provide the following advantages.

(1) The energy for printing can be reduced. In the case of a printer adapted to be driven by means of a battery, in particular, reduced printing energy will result in a prolonged life of the battery.

(2) The pulse width can be narrowed of an electrical signal to be applied to a heating element of a thermal head for heating it. Hence, printing at an increased speed becomes feasible.

(3) Since the foundation is also made thin, there is a decrease in diffusion of the thermal energy given to the foundation from the heating element of the thermal head. This results in printed images of fineness.

(4) The length can be increased of an ink sheet in the form of an ink sheet roll (pancake) having a fixed diameter. Alternatively, if the length of an ink sheet is fixed, the diameter of the ink sheet roll can be decreased. This leads to a reduction in the size of an ink sheet cassette and hence to a printer of reduced size.

In view of the above, the present inventors have attempted to make a thermal transfer ink sheet thin by thinning both the foundation and ink layer thereof. As a result, the following problems have been found to occur.

A. Problems ascribable to a thinned foundation

(1) Rupture is likely during the manufacture of an ink sheet and during printing. In particular, when a pit or a perforation is produced in a heated portion of the foundation during printing, the ink sheet is deteriorated in its strength and, hence, tends to rupture.

(2) The travel properties of the ink sheet in manufacture and in printing are poor, resulting in frequent occurrences of wrinkles in the sheet. In addition, the ink sheet is prone to travel obliquely, leading to the occurrence of a fold of the ink sheet in a cassette.

B. Problems ascribable to a thinned ink layer

(1) When printing is conducted against a paper sheet of poor surface smoothness (hereinafter referred to as "rough paper"), void occurs in resulting printed images. It is a conventional practice in manufacturing an ink sheet for rough paper to increase the amount of a resin to be contained in a vehicle of the ink used to increase the cohesive force of the ink layer so that the ink layer would be transferred as bridging over depressed portions of rough paper. In this case, thinning the ink layer cannot assure a satisfactory bridging characteristic thereof, thus resulting in occurrence of void.

(2) The density of a printed image is decreased.

(3) An ink sheet is usually used in the form of an ink sheet roll (pancake). Blocking is a phenomenon appearing in the ink sheet roll such that a front side of the ink layer adheres to a back side of the foundation. To prevent this blocking, it is a common practice to incorporate particles into the ink layer. The particle size of the particles to be used needs to be smaller than the thickness of the ink layer. If it is larger than the thickness, severe unevenness of the surface of the ink layer will result, so that the transferability of ink becomes poor. Since the particle size effective in antiblocking is usually 2 μm or larger, particles for antiblocking cannot be incorporated into a thinned ink layer.

It is a primary object of the present invention to provide a thin thermal transfer ink sheet which solves the foregoing problems arising when the foundation and ink layer thereof are made thin.

This and other objects of the invention will become apparent from the description hereinafter.

According to a first aspect of the present invention, there is provided a foundation for use in a thermal transfer ink sheet, comprising a film comprising a polyester resin having an average molecular weight of 12×10^3 to 30×10^3 , the film having a thickness of 1.5 to 3.0 μm and a heat shrinkage ratio of 3 % or lower in the longitudinal direction and 2 % or lower in the transverse direction.

In a first embodiment of the first aspect of the present invention, the aforesaid film has a coefficient of kinetic friction of 0.6 or smaller.

In a second embodiment of the first aspect of the present invention, the aforesaid film contains 1 to 30 % by weight of particles having an average particle size of 0.1 to 5 μm .

According to a second aspect of the present invention, there is provided a thermal transfer ink sheet comprising the aforesaid film and a heat-meltable ink comprising a coloring pigment and a heat-meltable

vehicle and applied on one side of the film in an amount of 1.5 to 2.5 g/m².

In a first embodiment of the second aspect of the present invention, the aforesaid heat-meltable vehicle comprises a heat-meltable resin component as its major component, the resin component containing a heat-meltable resin having a melt flow rate of not more than 1,200 g/10 min in an amount of not less than 30 % by weight on the basis of the weight of the vehicle.

In a second embodiment of the second aspect of the present invention, the aforesaid coloring pigment is contained in the heat-meltable ink in an amount of 20 to 60 % by weight.

In the present invention, the foundation is 1.5 to 3.0 μm thick and the amount of the heat-meltable ink to be applied thereon is 1.5 to 2.5 g/m² and, hence, the overall thickness of the thermal transfer ink sheet is made small enough, for example, 3.0 to 5.5 μm.

Further, in the present invention, the foregoing problems ascribable to the case where the foundation and the ink layer are made thin are solved as follows.

A. Solutions to the problems ascribable to a thinned foundation

(1) Since a film made of a polyester resin having an average molecular weight as large as 12×10^3 to 30×10^3 is used as the foundation, the foundation exhibits a large strength even when made thin and is, hence, hard to rupture during the manufacture of the ink sheet and during printing.

By virtue of its large molecular weight the foundation is highly heat resistant, so that pits or perforations are hard to produce in portions heated in printing. Further, because of its low heat shrinkage ratio, pits or perforations even when produced will not grow large, so that a rupture of the foundation will not result.

In addition, by incorporating particles into the film (first embodiment of the first aspect), the film can be further improved in its strength and heat resistance, leading to further lessened probability of rupture.

(2) The incorporation of particles into the film (first embodiment of the first aspect) also contributes to a decrease in the coefficient of kinetic friction of the film. This leads to an ink sheet of good travel properties with wrinkles or folds hard to occur. In addition, an antiblocking effect will also result.

B. Solutions to the problems ascribable to a thinned ink layer

(1) There is used in the heat-meltable ink a vehicle containing a heat-meltable resin component as its major component which resin component contains a heat-meltable resin having a melt flow rate of 1,200 g/10 min or lower in an amount of not less than 30 % by weight on the basis of the weight of the vehicle (first embodiment of the second aspect), and therefore the cohesive force of the heat-meltable ink layer is large, so that the occurrence of void is avoided.

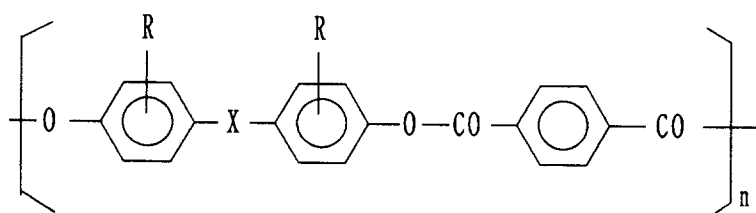
(2) Since the amount of the coloring pigment contained in the heat-meltable ink is large, or 20 to 60 % by weight (second embodiment of the second aspect), the density of a printed image is sufficiently high even when the ink layer is made thin.

(3) The content of the coloring pigment in the heat-meltable ink is as large as 20 to 60 % by weight. The coloring pigment in such a large proportion is found to serve also as an antiblocking agent. For this reason, antiblocking can be achieved without specially providing particles as an antiblocking agent.

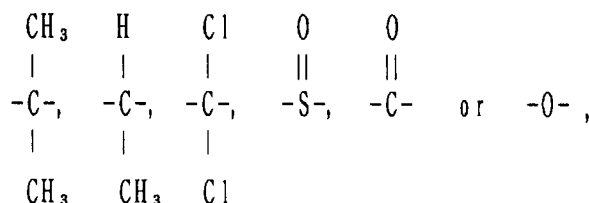
The present invention will now be described specifically.

The foundation of the present invention for use in a thermal transfer ink sheet comprises a film of a polyester resin having an average molecular weight (number average molecular weight, hereinafter the same) of 12×10^3 to 30×10^3 and a thickness of 1.5 to 3.0 μm. The film has a heat shrinkage ratio (JIS C2318, 150 °C × 2 hrs.) of 3 % or lower in the longitudinal direction and 2 % or lower in the transverse direction.

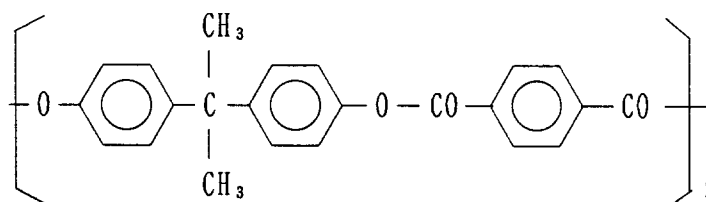
Examples of the polyester resin include polyethylene terephthalate (PET), polyethylene naphthalate (PEN), polyarylate (PAR) of the formula:



where R represents a hydrogen atom or a lower alkyl group such as methyl, and X represents:



particularly of the formula:



and polybutylene terephthalate (PBT), provided that these polyester resins each have an average molecular weight of 12×10^3 to 30×10^3 . Among these, especially preferable are polyethylene terephthalate (PET) and polyethylene naphthalate (PEN).

If the polyester resin has an average molecular weight of smaller than 12×10^3 , the film is poor in strength and in heat resistance and, hence, perforations are likely during the manufacture of the ink sheet or during printing in its heated portions in particular. This undesirably renders the film rupture-prone. If the polyester resin has an average molecular weight of larger than 30×10^3 , it is difficult to make the film thin and, hence, difficult to obtain a thinned film of a constant thickness.

If the thickness of the film exceeds $3.0 \mu\text{m}$, the object of the present invention, or making an ink sheet thin, cannot be attained. On the other hand, the thickness of the film is smaller than $1.5 \mu\text{m}$, the strength of the film is undesirably poor.

If the heat shrinkage ratio of the film is higher than 3 % in the longitudinal direction and than 2 % in the transverse direction, the film undesirably tends to rupture when pits or perforations are produced due to heating by a thermal head during printing.

The polyester resin film is usually a biaxially stretched film of which the stretching ratio is about 2.5 to about 5 in the longitudinal direction and about 3 to about 5 in the transverse direction.

It is preferable to incorporate particles into the polyester resin film so as to improve the strength of the film and set the coefficient of kinetic friction thereof (ASTM D-1894E method) at 0.6 or smaller.

There may be used for the particles inorganic particle materials such as calcium carbonate, silica, kaolin and talc. Preferably, the particles have an average particle size ranging from 0.1 to $5 \mu\text{m}$ and the content of the particles in the film ranges from 1 to 30 % by weight.

Particles having an average particle size smaller than the above range would result in an unsatisfactory effect of decreasing the coefficient of kinetic friction of the film and in frequent blocking between the front and back sides of the film when applied with an ink layer and rolled. Particles having an average particle size exceeding the above range would result in a thermal transfer ink sheet exhibiting poor printing characteristics. If the film contains particles in an amount smaller than the above range, there cannot be expected satisfactory effects in improving the strength thereof and in decreasing the coefficient of kinetic friction thereof. If the content of particles is larger than the above range, the overall physical properties of the film are degraded as well as the printing properties thereof.

The film may be provided on its back side (the side coming into slide contact with a thermal head) with a stick-preventive layer for preventing a stick phenomenon such that the film is fusion-bonded to the thermal head. Examples of the material for the stick-preventive layer include heat-resistant resins such as a silicone resin, fluorine-containing resin or nitrocellulose resin, and resins modified with these resins (for example, silicone-modified polyurethane resins). Further, these resins may be incorporated with a lubricant. From the viewpoint of reducing the overall thickness of the foundation, it is desired to make also the stick-preventive layer as thin as possible unless it loses its stick-preventive function. For example, the thickness

of the stick-preventive layer is preferably about 0.01 to about 0.5 μm .

The aforesaid foundation for use in a thermal transfer ink sheet is applicable to various types of thermal transfer ink sheets. Examples of such thermal transfer ink sheets include one having a heat-meltable ink layer for one-time use on one side of the foundation, one having a heat-meltable ink layer for multiple use (the ink layer can be transferred as partially and gradually consumed in the direction of the thickness thereof upon every heating) on one side of the foundation, one having a non-transferable porous layer impregnated with a heat-meltable ink on one side of the foundation, and one having a non-transferable resin layer containing a heat-transferable dye (for example, a heat-sublimation dye) on one side of the foundation. The foundation exhibits its excellent effects especially when applied to a one-time thermal transfer ink sheet wherein a heat-meltable ink is applied on the foundation in an amount of 1.5 to 2.5 g/m^2 (the amount of the ink after dried, hereinafter the same) and the overall thickness of the ink sheet is 3.0 to 5.5 μm .

Usable as the aforesaid heat-meltable ink is any widely-used conventional one comprising a heat-meltable vehicle and a coloring agent. From the viewpoint of solving the above-mentioned problems ascribable to a thinned ink layer, the heat-meltable vehicle preferably comprises a heat-meltable resin component as a major component, the resin component containing a heat-meltable resin having a melt flow rate (JIS K7210) of 1,200 g/10 min or lower in an amount of not less than 30 % by weight, more preferably not less than 50 % by weight, on the basis of the weight of the vehicle. Further, the melt flow rate of the overall vehicle is preferably set within the range of 50 to 2,500 g/min. If the melt flow rate of the vehicle is lower than that range, the ink is small in cohesive force and, hence, the occurrence of void is likely. On the other hand, if it is larger than the range, the thermal transfer sensitivity of the ink is low, resulting in printed images prone to be blurred. If the proportion of the heat-meltable resin having the specified melt flow rate is smaller than the aforesaid range, it is difficult to adjust the melt flow rate of the vehicle to a value falling within the aforesaid range, so that frequent occurrences of void would result. The proportion of the heat-meltable resin component in the vehicle is preferably not less than 30 % by weight, more preferably not less than 50 % by weight. The proportion thereof less than the above range would result in an ink of undesirably decreased cohesive force.

Examples of heat-meltable resins used as the heat-meltable resin component of the heat-meltable vehicle include ethylene copolymers such as ethylene-vinyl acetate copolymer, ethylene-vinyl butyrate copolymer, ethylene-(meth)acrylic acid copolymer, ethylene-alkyl (meth)acrylate copolymer wherein examples of the alkyl group are those groups having 1 to 16 carbon atoms, such as methyl, ethyl, propyl, butyl, hexyl, heptyl, octyl, 2-ethylhexyl, nonyl, dodecyl and hexadecyl, ethylene-acrylonitrile copolymer, ethylene-acrylamide copolymer, ethylene-N-methylolacrylamide copolymer and ethylene-styrene copolymer; poly-(meth)acrylic acid esters such as polydodecyl methacrylate and polyhexyl methacrylate; vinyl chloride polymers and copolymers such as polyvinyl chloride, vinyl chloride-vinyl acetate copolymer and vinyl chloride-vinyl alcohol copolymer; polyesters such as sebacic acid-decanediol polymer, azelaic acid-dodecanediol polymer and azelaic acid-hexadecanediol polymer; and polyamides. These resins may be used either alone or in combination.

Usable as the heat-meltable resin having a melt flow rate of 1,200 g/10 min or lower are those having such a melt flow rate of the aforementioned heat-meltable resins. Among those, ethylene-vinyl acetate copolymer is especially preferable.

The aforesaid vehicle may contain, in addition to the heat-meltable resin, a wax substance as far as the melt flow rate of the overall vehicle falls within the range of 50 to 2,500 g/10 min.

In the present invention it is preferable to incorporate a tackifier resin into the vehicle so as to improve the transferability of the ink layer. The incorporation of a tackifier resin into the vehicle will enhance the adhesiveness of the ink layer with respect to a receptor paper without affecting the viscosity of the ink so much, thereby improving the transferability of the ink layer.

Examples of such a tackifier resin include, as natural tackifier resins, rosins such as hydrogenated rosins, disproportionated rosins, polymerized rosins and rosin esters, rosin-modified resins such as rosin-modified phenolic resins, rosin-modified maleic acid resins and rosin-modified xylene resins, terpene resins obtained from polyterpenes, aromatic compound-modified terpenes, terpene phenols and hydrogenated terpenes, and terpene resins such as terpene-phenol-formaldehyde resins; and, as synthetic tackifier resins, petroleum resins such as resins of C_5 aliphatic or alicyclic hydrocarbons and derivatives thereof, resins of C_9 aromatic or alicyclic hydrocarbons and derivatives thereof, homopolymers or copolymers of styrene, α -methylstyrene or vinyltoluene, dicyclopentadiene resins, aromatic addition-condensation type petroleum resins and coumarone-indene resins, and other synthetic resins such as xylene resins, phenolic resins and styrene-maleic anhydride copolymer resins.

The proportion of the tackifier resin in the ink is preferably in the range of 5 to 20 % by weight. If the proportion of the tackifier resin is smaller than that range, the effects thereof will not appear and, hence, the

transferability of the ink layer cannot be expected to improve. On the other hand, the proportion exceeding the range would cause the cohesive force of the ink to decrease, so that the transferability of the ink layer against rough paper is degraded.

The content of the coloring pigment in the heat-meltable ink is preferably 20 to 60 % by weight so as to assure a satisfactory density of printed images. The coloring pigment contained in such a large amount would serve to prevent blocking even in the absence of particles for use as the antiblocking agent.

As the coloring pigment, those conventionally used in this type of thermal transfer ink sheet can be used without particular limitations. Usable coloring pigments are exemplified as follows.

Examples of specific coloring pigments for black include Carbon Black and Nigrosine Base.

Examples of specific coloring pigments for yellow include Naphthol Yellow S, Hansa Yellow 5G, Hansa Yellow 3G, Hansa Yellow G, Hansa Yellow GR, Hansa Yellow A, Hansa Yellow RN, Hansa Yellow R, Benzidine Yellow G, Benzidine Yellow GR, Permanent Yellow NCG and Quinoline Yellow Lake. These coloring pigments may be used either alone or in combination.

Examples of specific coloring pigments for magenta include Permanent Red 4R, Brilliant Fast Scarlet, Brilliant Carmine BS, Permanent Carmine FB, Lithol Red, Permanent Red F5R, Brilliant Carmine 6B, Pigment Scarlet 3B, Rhodamine Lake B, Rhodamine Lake Y and Arizalin Lake. These coloring pigments may be used either alone or in combination.

Examples of specific coloring pigments for cyan include Victoria Blue Lake, metal-free Phthalocyanine Blue, Phthalocyanine Blue and Fast Sky Blue. These coloring pigments may also be used either alone or in combination.

Any colors other than the above-mentioned may be developed by appropriately combining the coloring pigments as specified above. For instance, blue black is obtained by combining a coloring pigment for black with one for cyan. A dye may be used in addition to a coloring pigment.

To further improve the antiblocking properties of the ink sheet, the heat-meltable ink may be incorporated with a surface modifier. Examples of the surface modifier include wax substances such as fatty acid amides, and like substances. The surface modifier is usually incorporated in a proportion of 0.2 to 1 % by weight relative to the total amount of the ink.

In the present invention, as required, there may further be incorporated into the heat-meltable ink an additive such as a dispersant or an antioxidant.

In the present invention, if the releasability of the ink layer from the foundation is poor because of the heat-meltable ink having a high cohesive force, it is preferable to provide a release layer intermediate between the foundation and the ink layer.

Preferably, such a release layer comprises a wax substance as the major component. Examples of the wax substance include polyethylene wax, α -olefin wax, Fischer-Tropsch wax, paraffin wax, microcrystalline wax, candelilla wax and carnauba wax. The release layer may be incorporated with a small amount of a heat-meltable resin such as ethylene-vinyl acetate copolymer to enhance the adhesiveness thereof with respect to the foundation.

From the viewpoint of making the overall ink sheet thin, it is preferable to make also the release layer as thin as possible, unless the function of the release layer is lost.

The present invention will be described by way of Experimental Examples. It is to be understood that the present invention is not limited to the Examples, and various changes and modifications may be made in the invention without departing from the spirit and scope thereof.

Experimental Examples 1 to 10

Thermal transfer ink sheets of respective total thickness shown in the following Table 1 were each fabricated by forming a release layer on one side of a polyethylene terephthalate (PET) film shown in Table 1 and forming an ink layer by applying on the release layer a solution of an ink composition shown in Table 1 in a mixed solvent of toluene/ethylene glycol monomethyl ether (43/7 in weight ratio). Note that where a stick-preventive layer was provided on one side of the PET film, the release layer and the ink layer were formed on the other side thereof.

Table 1

	Exp. Ex.									
	1	2	3	4	5	6	7	8	9	10
Thickness (μ m)	2.5	2.5	2.5	1.8	2.5	2.5	2.5	2.5	2.5	2.5
Average molecular weight	16×10^3	13×10^3	28×10^3	28×10^3	10×10^3	16×10^3	16×10^3	16×10^3	16×10^3	16×10^3
Heat shrinkage ratio (%)										
PET film										
in MD	2.6	2.6	2.6	2.6	2.6	5	2.6	2.6	2.6	2.6
in TD	1.2	1.2	1.2	1.2	1.2	5	1.2	1.2	1.2	1.2
Particle *1	P1	P1	P1	P1	P1	P1	-	P1	P1	P1
Coefficient of kinetic friction	0.54	0.54	0.54	0.54	0.54	0.54	0.74	0.54	0.54	0.54
Stick-preventive layer *2	-	SI	-	-	-	-	-	-	-	-
EVA-I *3	38.0	38.0	38.0	38.0	38.0	38.0	38.0	-	38.0	18.0
EVA-II *4	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	-
Polyester resin *5	-	-	-	-	-	-	-	38.0	-	-
Hydrogenated alicyclic hydrocarbon resin	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	-
Low-molecular-weight EVA *6	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	-

- continued -

Each of the thermal transfer ink sheets thus fabricated was subjected to the following tests. The results
55 of the tests are shown in Table 2.

(1) Perforation

Using a Japanese word processor (RUPO 95HP made by TOSHIBA CORPORATION), each ink sheet was subjected to printing at a travel speed of 10 in. /sec. After printing, the ink sheet was observed with an optical microscope to determine whether or not there was an abnormality such as perforations or cracks in heated portions of the sheet.

- 2 Abnormality was found
- 1 No abnormality was found

(2) Rupture

Each ink sheet was subjected to printing in the same manner as in test (1), and determined whether it was ruptured or not.

- 2 Ink sheet was not ruptured
- 1 Ink sheet was ruptured

(3) Travel property (slip ratio)

Each ink sheet was subjected to printing in the same manner as in test (1). Using the following equation the slip ratio r_s of the ink sheet was found to evaluate its travel property.

$$r_s (\%) = (1 - L_2/L_1) \times 100$$

where L_1 is a predetermined ink sheet length for printing one line of characters, and L_2 is a corresponding ink sheet length actually consumed for printing one line of characters.

- 3 $r_s \leq 10 \%$
- 2 $10 \% < r_s \leq 15 \%$
- 1 $15 \% < r_s$

(4) Void

Using a serial thermal transfer printer (PC-PR 150V made by NEC Corporation), printing was performed at a maximum printing energy (15 mJ/mm²) against a rough paper having a Bekk smoothness of 30 seconds. The image thus printed was measured for its reflection density (in terms of OD value) to determine whether void existed or not.

- 3 1.5 or larger in OD value
- 2 1.0 or larger and smaller than 1.5 in OD value
- 1 smaller than 1.0 in OD value

(5) Density of printed image

In a manner similar to test (4), printing was performed against a smooth paper having a Bekk smoothness of 500 seconds, and the image thus printed was measured for its reflection density (in terms of OD value).

- 3 1.5 or larger in OD value
- 2 1.0 or larger and smaller than 1.5 in OD value
- 1 smaller than 1.0 in OD value

(6) Blocking

Each ink sheet (width: 13 mm) in the form of a pancake was allowed to stand in a high-temperature environment (50 °C, 85 % RH) for four days, and then determined for its blocking state.

- 3 Force of not larger than 3 g required to unroll the ink sheet
- 2 Force of larger than 3 g required to unroll the ink sheet
- 1 Ink layer was exfoliated from foundation and adhered to the back of foundation upon unrolling

Table 2

		Exp. Ex.									
		1	2	3	4	5	6	7	8	9	10
Perforation	2	2	2	2	2	1	1	2	2	2	2
Rupture	2	2	2	2	2	1	1	2	2	2	2
Travel property	3	2	2	3	2	1	1	1	3	3	3
Void	3	3	3	3	3	(*)	(*)	(*)	2	3	1
Print density	3	3	3	3	3	(*)	(*)	(*)	2	3	2
Blocking	3	3	3	3	3	3	3	3	3	2	1

*: Impossible to evaluate due to faulty travel

From the results shown in Table 2, the following are found.

If a PET film made of a PET having an average molecular weight of 12×10^3 to 30×10^3 and of which heat shrinkage ratio is 3 % or lower in the longitudinal direction and 2 % or lower in the transverse direction is used as the foundation of an ink sheet, the ink sheet does not suffer from perforation or rupture and enjoys a good travel property even when the foundation is as thin as 1.5 to 3.0 μm (refer to Experimental

Examples 1-4 and 8-10).

In contrast, the use of a thin PET film made of a PET having an average molecular weight of smaller than 12×10^3 results in an ink sheet susceptible to perforation or rupture with poor travel property (refer to Experimental Example 5). Alternatively, the use of a thin PET film having a heat shrinkage ratio larger than the range defined in the present invention results in an ink sheet susceptible to perforation or the like with poor travel property (refer to Experimental Example 6). Otherwise, the use of a thin PET film having a coefficient of kinetic friction of larger than 0.6 results in an ink sheet of poor travel property (refer to Experimental Example 7).

If a heat-meltable ink is used comprising a heat-meltable vehicle containing a heat-meltable resin component as its major component and 30 % or more by weight of a heat-meltable resin having a melt flow rate of 1,200 g/10 min or lower; carbon black in an amount of 20 % or more by weight; and a surface modifier, the ink sheet in which the heat-meltable ink is used assures voidless printed images of a high print density while being free from blocking even when the amount of the ink applied is as small as 1.5 to 2.5 g/m² (refer to Experimental Examples 1-4). Note that if the surface modifier is not used, the antiblocking property is slightly degraded (refer to Experimental Example 9).

In contrast, if the content of the heat-meltable resin having a melt flow rate of 1,200 g/10 min or lower in the heat-meltable vehicle of the ink is less than 30 % by weight, the ink sheet using such an ink in an small coating amount suffers from conspicuous void and severe blocking (refer to Experimental Example 10).

According to the present invention, a thermal transfer ink sheet is provided which, despite its thinned foundation and thinned ink layer, has good travel properties, scarcely ruptures, and assures voidless printed images of a high density, with blocking being prevented. Consequently, by virtue of its thinned foundation and thinned ink layer the thermal transfer ink sheet offers the advantages: reduction in energy to be consumed for printing, increase in printing speed, improvement in fineness of printed image, elongation of ink sheet in the form of a pancake of a fixed size, down-scaling of a cassette for ink sheet, down-sizing of a printer, and other advantages.

In addition to the materials and ingredients used in the Examples, other materials and ingredients can be used in the Examples as set forth in the specification to obtain substantially the same results.

Claims

1. A foundation for use in a thermal transfer ink sheet, comprising a film comprising a polyester resin having an average molecular weight of 12×10^3 to 30×10^3 , the film having a thickness of 1.5 to 3.0 μm and a heat shrinkage ratio of not more than 3 % in the longitudinal direction and not more than 2 % in the transverse direction.
2. The foundation of Claim 1, wherein the film has a coefficient of kinetic friction of not more than 0.6.
3. The foundation of Claim 1, wherein the film contains 1 to 30 % by weight of particles having an average particle size of 0.1 to 5 μm .
4. The foundation of Claim 2, wherein the film contains 1 to 30 % by weight of particles having an average particle size of 0.1 to 5 μm .
5. A thermal transfer ink sheet comprising:
 - a film comprising a polyester resin having an average molecular weight of 12×10^3 to 30×10^3 , the film having a thickness of 1.5 to 3.0 μm and a heat shrinkage ratio of not more than 3 % in the longitudinal direction and not more than 2 % in the transverse direction, and
 - a heat-meltable ink applied on one side of the film in an amount of 1.5 to 2.5 g/m².
6. The thermal transfer ink sheet of Claim 5, wherein the film has a coefficient of kinetic friction of not more than 0.6.
7. The thermal transfer ink sheet of Claim 5, wherein the film contains 1 to 30 % by weight of particles having an average particle size of 0.1 to 5 μm .
8. The thermal transfer ink sheet of Claim 6, wherein the film contains 1 to 30 % by weight of particles having an average particle size of 0.1 to 5 μm .

9. The thermal transfer ink sheet of Claim 5, which has an overall thickness of 3.0 to 5.5 μm .
10. The thermal transfer ink sheet of Claim 5, wherein the heat-meltable ink comprises a coloring pigment and a heat-meltable vehicle.
- 5 11. The thermal transfer ink sheet of Claim 10, wherein the heat-meltable vehicle comprises a heat-meltable resin component, the resin component containing a heat-meltable resin having a melt flow rate of not more than 1,200 g/10 min in an amount of not less than 30 % by weight on the basis of the weight of the vehicle.
- 10 12. The thermal transfer ink sheet of Claim 10, wherein the coloring pigment is contained in the heat-meltable ink in an amount of 20 to 60 % by weight.

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EUROPEAN SEARCH REPORT

Application Number
EP 93 12 0572

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	EP-A-0 222 374 (DIAFOIL COMPANY) * page 10, line 11 - page 13, line 15; example 2 * ---	1,3,5,7, 9-12	B41M5/40
X	EP-A-0 356 904 (DIAFOIL COMPANY) * page 3, line 24 - line 27; example 1 * ---	1,3,5,7, 10	
A	WO-A-92 07721 (MINNESOTA MINING AND MANUFACTURING COMPANY) * page 11, line 11 - line 15; example 7; table 1 * ---	1,2,5,6, 10-12	
A	AGGARWAL, S.L. 'Comprehensive Polymer Science. Volume 7.' 1989, PERGAMON PRESS, GB * page 254 - page 256 * -----	1,5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			B41M
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28 April 1994	Examiner Bernardo Noriega, F
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	