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(54) Thermal transfer ink and film.

(57) A thermal transfer ink composition for an ink ribbon for repeated printing, comprises a resin having a melting point according to JIS-K0064 of 55 to 110 °C and a solidification point according to JIS-K0064 being lower at least 5 °C than the melting point and a coloring matter.

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Thermal Transfer Ink and Film

The present invention relates to thermal transfer recording ink and ink film, and is more specifically aiming at providing a thermal transfer ink ribbon capable of being used repeatedly to reduce the printing cost in a thermal transfer recording system which is widely employed in personal word processers or the like today.

(Statement of Prior Arts)

Thermal transfer printers are widely utilized as printers of a popular type by virtue of their small sizes, light weights, and low prices. Particularly by virtue of their maintenance-free feature, they have a share of substantially 100% in the field of personal word processers and the like.

Thus, the thermal transfer printing system is endowed with a number of advantages for use in printers of a popular type. It is, however, anticipated that a high printing cost per sheet of paper will become the biggest hindrance in a further spread of thermal transfer printers from now on because the above-mentioned system necessitates expensive consumables. This high cost ensues from various causes including inevitable production of a wide variety of cassettes in small quantities which results from the necessity of supplying various kinds of cassettes respectively adapted to various kinds of printers, a considerably high price of cassettes as the related part other than essential consumables when compared with that of ribbons, a difficulty encountered in automating a series of post-fabrication steps such as slitting, core winding, and cassette packing which results in high personnel expenses, and a high distribution cost.

(Summary of the Invention)

In view of the above-mentioned problems, the inventors of the present invention have made intensive investigations with a view to providing consumables for a thermal transfer printer to realize a low printing cost by using the same ink ribbon repeatedly, and have completed the present invention.

The invention provides a thermal transfer ink composition for an ink ribbon for repeated printing, which comprises a resin having a melting point according to JIS-K0064 of 55 to 110°C and a solidification point according to JIS-K0064 being lower at least 5°C than the melting point and a coloring matter.

It is preferable that the composition comprises 20 to 80 wt.% as the solid component of the resin.

It is preferable that the resin has a melt viscosity of 10,000 cps or lower at 120° C and is selected from a polyamide, a styrene resin, a polyester, polyethylene, a polyether, a copolymer of styrene and acrylic acid and a phenolic resin.

The invention also provides a thermal transfer ink film for repeated printing, which comprises a substrate and the composition as defined above, coated on the substrate.

Specifically, the present invention provides a thermal transfer ink for repeated printing to be used in an ink ribbon for repeated printing having thereon a non-transfer structure from which molten ink oozes, characterized by comprising as the indispensable components a resin having a melting point (according to JIS-K0064) of 55 to 110° C and a solidification point according to JIS-K0064 being lower by at least 5° C than the melting point and a coloring matter, and a thermal transfer ink film capable of effecting repeated printing, characterized by comprising a support and an ink of the kind as mentioned above applied on one surface thereof.

According to the present invention, the ink is retained in the non-transfer structure such as a network structure or a stonework structure and transferred little by little at the time of thermal printing to realize repeated printing.

The thermal transfer printing system comprises melting a hot-melt ink applied on a base film such as polyethylene terephthalate (PET) film by heating the ink from the back side of the base film with a thermal head to sufficiently infiltrate the ink into a paper for transfer or adhere the ink to the paper, and subsequently mechanically peeling off the base film from the paper to transfer the ink from the base film to the paper. Conventional ink ribbons are disposable ribbons which can be used only once because the whole of the molten ink is transferred to the paper owing to cooling and solidification thereof during peeling. In contrast, in the case of a ribbon comprised of the ink film of the present invention, the ink maintains a molten state even when the film is peeled from the paper by virtue of a difference between the melting point and freezing point thereof and oozes little by little in a molten state from a non-transfer structure such as a network structure to transfer not the whole but part of the molten ink to the paper, whereby repeated printing can be achieved.

Any resin can be used in the present invention in so far as it has a melting point (according to JIS-K0064) falling within a temperature range which can be attained with a common thermal transfer printer head, namely 55 to 110 °C, and a solidification point (JIS-K0064) lower by at least 5 °C than the melting point thereof. Examples of such a resin include polyamide, polystyrene, polyester, polyethylene, polyether, polystyrene/acrylic copolymer, and phenolic resins. Those having a melt viscosity at 120 °C of 10,000 cps or lower are particularly preferred. These resins may be partially crosslinked with a crosslinking agent, provided that the resultant crosslinked resins have a difference of at least 5 °C between the melting point and freezing point thereof. The amount of such a resin to be blended in the ink is preferably 20 to 80 wt.% (based on the solids content).

The ink of the present invention may not comprise only the above-mentioned resin but may further comprise a common wax, a low-molecular substance, or a resin falling outside the above-mentioned category

A wide variety of known dyes and pigments of yellow, red, blue, black and the like colors can be used as the coloring agent in the present invention without any particular limitation. For example, usable black pigments include carbon black and oil black.

The ink composition comprising the above shown additive is preferred to have a solidification point being at least 5 °C lower than a melting point or softening point.

The method for determing a melting point and a solidification point of the resin according to JIS-K0064, called the transparent method, does not apply to the ink composition with success. The melting point and the solidification point of the ink composition is determined by measurement of changes of viscoelasticity with temperatures. In the invention, a device using a rigid pendulum, DDV-OPA (tradename) being available from Orientech Co., Ltd., is used to determine viscoelasticity. A melting point or a solification point is determined at the maximum change of a delta value or a change cycle while a sample to test is being heated or cooled at a rate of 1 to 5 °C per minute.

The ink of the present invention is used in the form of a hot-melt or solvent-based ink at the time of application thereof on a support. It is, however, preferable to use a solvent-based ink from the viewpoint of adjustment of ink viscosity, accuracy of coating film thickness, and the like. In the case of a solvent-based ink, a solvent capable of perfectly dissolving a resin to be used may be used to prepare an ink containing the resin homogeneously dissolved in the solvent, or a solvent having a low capability of dissolving therein a resin to be used may be used in combination with the resin to prepare an ink containing the resin, at least part of which is dispersed in the form of fine particles in the solvent.

The non-transfer structure mentioned in the present invention may be formed either by applying a filler, a fine powder, a high-viscosity resin, a non-hot-melt resin, or the like on a base film before application thereon of the ink, or by dispersing these structural components in the ink and applying the same together with the ink on a base film. Alternatively, any method can be employed, including one comprising applying an ink containing a reactive monomer on a base film and drying the same to polymerize the monomer to thereby form a structure.

A support to be used in the thermal transfer recording ink film of the present invention is desired to have high high-temperature strength, dimensional stability and surface smoothness. Specific preferred examples of the support include resin films having a thickness of 2 to 20 μ and made of polyethylene terephthalate which has been mainly used as the material of base films of conventional thermal transfer recording ink films, polycarbonate, polyethylene, polystyrene, polypropylene, or polyimide.

When a printing test was made using a ribbon comprised of an ink film formed using an ink satisfying the requisites specified in the present invention to repeat black solid printing 5 times using the same ribbon, the optical density (measured with a Macbeth illuminometer) was 1.0 or higher till the third printing and as considerably high as 0.8 even in the fifth printing, thus proving that the ink has a high performance as an ink for repeated printing.

[Brief Description of Drawing]

Fig. 1 is a graphical representation showing the variations of the optical densities of prints with the number of runs of printing using the ink ribbons obtained in Example 1 and Comparative Example 1; Fig. 2 is a graphical representation showing the variation of the optical density of a print with the number of runs of printing using the ink ribbon obtained in Example 2; and Fig. 3 is a graphic representation showing the variation of the optical density of a print with the number of runs of printing using the ink ribbon obtained in Example 3.

[Examples]

The following Examples will now illustrate the present invention in more detail, but they should not be construed as limiting the scope of the invention.

Example 1

An ink having the following composition was prepared using a polyester resin having a melting point of 72 °C, a freezing point of 64 °C (difference between the melting point and the solidification point: 8 °C), and a melt viscosity at 120 °C of 180 cps. polyester resin 55%
ethylene/vinyl acetate resin 12%
carnauba wax 9%
dispersant 4%
carbon black 20%

A crosslinked methyl methacrylate resin powder of 0.5µm was added in an amount of 40% in terms of a solids content to the ink, followed by application of the resulting mixture on a 6µm-thick PET film to form a dry coating of 8 g/m^2.

The resulting ink sheet was used to evaluate the printing performance thereof with a commercially available thermal transfer printer (personal word processer Model Bungo Mini 7E manufactured by NEC). Evaluation was made repeatedly by black solid printing. The same portion of the ribbon was used a plurality of times to examine the variation of the optical density (measured with a Macbeth illuminometer) of a print with the number of runs of printing. The results are shown in Fig. 1.

As is apparent from Fig. 1, optical densities exceeding 1.0 were secured till the third printing, thus proving that the ink has a high performance as an ink for repeated printing.

Comparative Example 1

An ink having substantially the same composition as that of Example 1 except for inclusion of Wax HNP-10 (melting point: 75 °C, solidification point: 75 °c) manufactured by Nippon Seiro Co., Ltd. instead of the polyester resin was prepared and examined with respect to the printing performance thereof in the same manner as that of Example 1.

The results are shown in Fig. 1. Substantially the whole of the ink was transferred in the first printing, with the result that repeated use of the ribbon was impossible.

Example 2

An ink having substantially the same composition as that of Example 1 except for use of a modified polyethylene resin having a melting point of 72 °C, a freezing point of 62 °C (difference between the melting point and the freezing point: 10 °C), and a melt viscosity at 120 °C of 250 cps was prepared and examined with respect to the printing performance thereof in the same manner as that of Example 1. The results are shown in Fig. 2.

As is apparent from Fig. 2, very uniform prints were obtained repeatedly although the optical densities thereof were slightly low.

Example 3

A diisocyanate (Takenate D-110N manufactured by Takeda Chemical Industries, Ltd.) was blended in an amount of 5% in terms of a solids content with the ink as described in Example 1 and the resulting mixture was applied and dried on a 6 µm-thick PET film in a thickness of 8 g/m^2 to form urethane bonds between the isocyanate groups of the diisocyanate and the residual hydroxyl groups of the polyester resin.

The ink sheet thus prepared was examined with respect to the printing performance thereof in the same manner as that of Example 1. The results are shown in Fig. 3.

As is apparent from Fig. 3, optical densities of at least 1.0 were secured till the third printing, thus proving that the ink has a high performance as an ink for repeated printing.

Claims

1. A thermal transfer ink composition for an ink ribbon for repeated printing, which comprises a resin having a melting point according to JIS-K0064 of 55 to 110 °C and a solidification point according to JIS-K0064 being lower at least 5 °C than the melting point and a coloring matter.

2. A composition as claimed in Claim 1, which comprises 20 to 80 wt.% as the solid component of the resin.

3. A composition as claimed in Claim 1, in which said resin has a melt viscosity of 10,000 cps or lower at 120 ° C.

4. A composition as claimed in Claim 1, in which said resin is selected from a polyamide, a styrene resin, a polyester, polyethylene, a polyether, a copolymer of styrene and acrylic acid and a phenolic resin.

5. A thermal transfer ink film for repeated printing, which comprises a substrate and the composition as defined in Claim 1, coated on the substrate.

Fig. 1

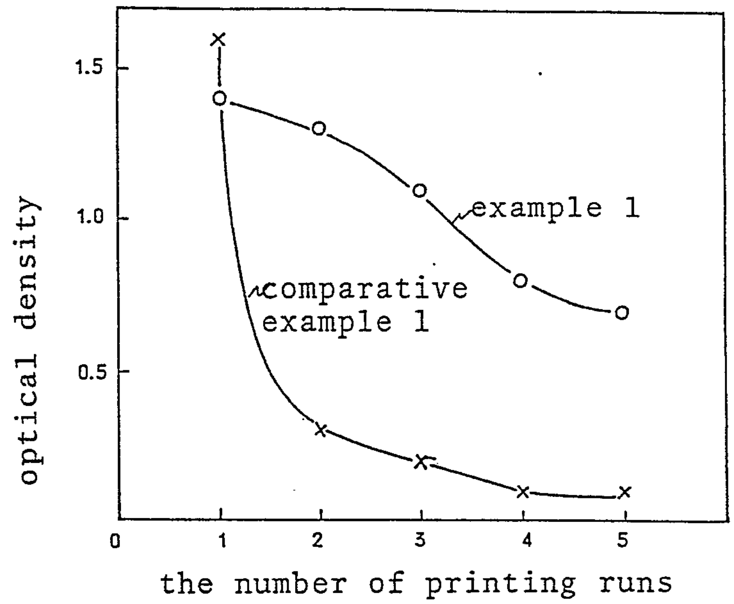

Fig. 2

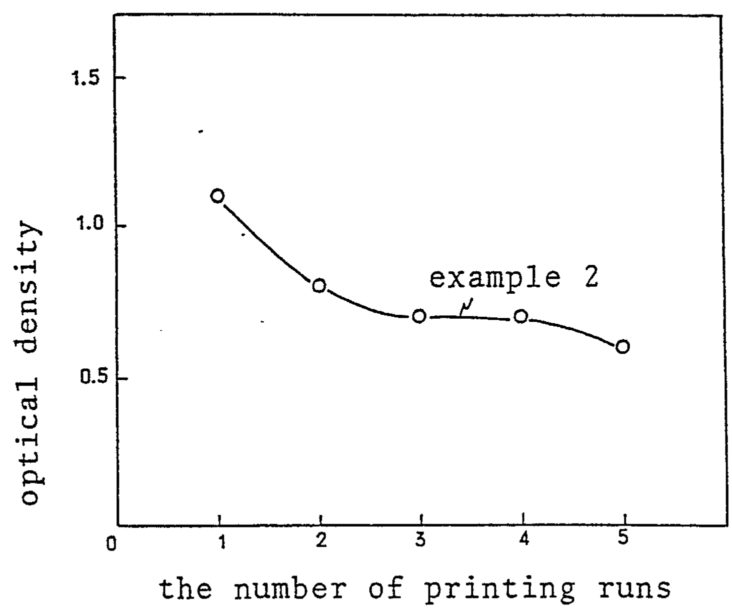

Fig. 3