

- [54] **THERMAL PRINTING PROCESS**
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- [52] **U.S. Cl.**..... **117/36.8, 250/316**
[51] **Int. Cl.**..... **B41m 5/18**
[58] **Field of Search**..... **117/36.8; 250/316**

[56] **References Cited**
UNITED STATES PATENTS

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|-----------|---------|----------------------|----------|
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Primary Examiner—Michael Sofocleous
Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper
& Scinto

[57] **ABSTRACT**

A thermal printing process is disclosed in which an image is formed on a heat-sensitive recording sheet composed of a support having superposed thereon a heat-sensitive layer which is composed of a heat-sensitive composition dispersed in a binder therefor, the process comprising contacting a thermally-heated print head with the surface of the heat-sensitive layer to thereby form the printed image thereon, wherein the improvement comprises eliminating exfoliation of the heat-sensitive layer by employing as the binder either methyl cellulose or acetyl cellulose having a melting point of not lower than 180°C.

3 Claims, 4 Drawing Figures

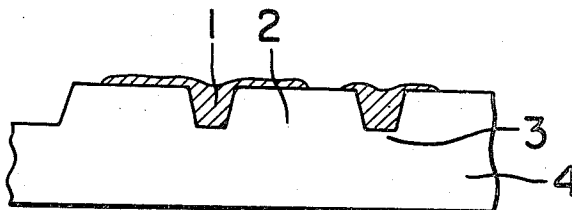


FIG. 1

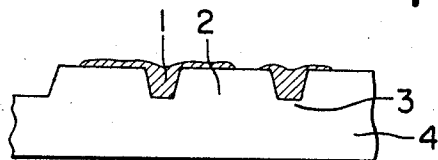


FIG. 2

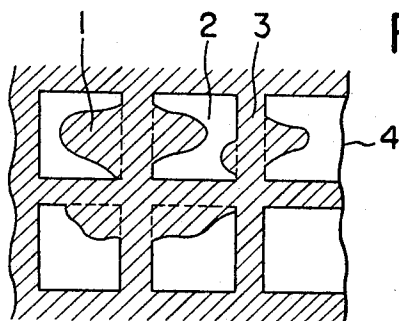


FIG. 3

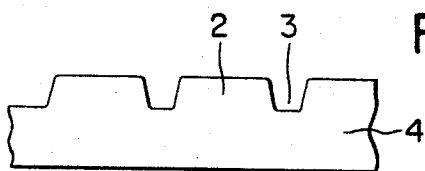
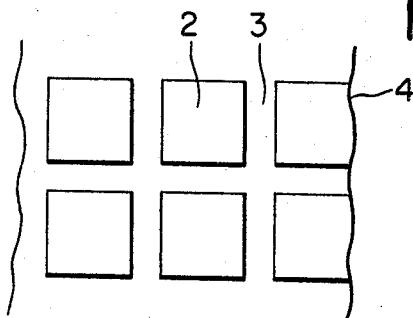


FIG. 4



THERMAL PRINTING PROCESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a thermal printing.

2. Description of the Prior Art

Thermal recording processes include direct recording and indirect recording. It is well known that the direct method has the advantage that a visible image can be directly produced while the indirect method disadvantageously requires a chemical treatment to produce a visible image. Thermal printing is among the direct recording processes, wherein a thermal printer is provided with a print head having an electric heating element. Recording is effected by bringing the electric heating element into contact with a heat sensitive sheet. In comparison with conventional mechanical processes, the direct heat sensitive recording process is high in printing speed, and less noisy so that it is suitable for an output of electronic computer operated at high speed. The utilization of these processes will increase as the stations are popularized.

Letters provided at the print head are usually composed of a matrix of dots, or several bars.

Conventional heat sensitive recording paper cannot be used as is for thermal printing. In conventional heat sensitive recording processes the heat is applied to the heat sensitive paper by an optical means by the projection of light a pattern thereon. On the contrary, in thermal printing processes a solid print head directly contacts the surface of the heat sensitive paper. This direct contact of the print head causes softening of the heat sensitive coating and exfoliation of the heat sensitive coating from the support which may be paper.

The coating thus exfoliated is attached to and deposited on the print head. This deposit disturbs the heat transfer from the print head to the heat sensitive recording paper and thereby results in unsatisfactory printing. Further the deposit is often formed irregularly and thereby a uniform print pattern cannot be obtained. Even if conventional heat sensitive recording paper can be used for the thermal printing, it cannot be regarded as practical unless more than ten million letters can be printed.

Heat-sensitive recording sheets proposed heretofore are those usable only for thermal duplicating with infra-red radiation, that is, so called "thermofax".

In thermal printing where the image is formed by chemical reaction, the reaction may be between two components, or one component may be converted into a third component which is reactable with the other component, or one component may be converted into a colored substance to form a coloring image, etc.

In such conventional heat sensitive recording sheets, the color forming materials have been markedly improved, but the prior art has not paid any particular attention to the binder material.

The present inventors have now found that the melting point and the adhesion property of the binder are very important in thermal printing.

SUMMARY OF THE INVENTION

According to the present invention there is provided a process for forming an image by thermal printing on a heat-sensitive recording sheet composed of a support and heat-sensitive layer overlying the support, the heat-sensitive layer being composed of a binder selected

from the group consisting of methyl cellulose and acetyl cellulose having a melting point of not lower than 180°C and a heat sensitive composition.

An object of the present invention is to provide a thermal printing process which is free from exfoliation of the heat sensitive coating from the support.

Another object of the present invention is to provide thermal printing process in which neither smudging of the print head nor irregular heat transfer of the print head occurs.

A further object of the present invention is to provide a process for preparing a heat-sensitive recording sheet for thermal printing as mentioned above.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURES show diagrammatically enlarged views of printing heads after they have been used with a conventional heat sensitive sheet and a heat sensitive sheet of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The binder used in the present invention is methyl-cellulose or acetylcellulose having a melting point of not lower than 180°C.

The preferred binders are (1) acetylcellulose having a weight average molecular weight ranging from 28,000 to 58,000, a degree of polymerization ranging from 175 to 360, and a viscosity (ASTM, E method, 20% concentration) ranging from 10 to 40 seconds, and added in an amount ranging from 40 to 70% by weight based on the total solids weight, and (2) methyl cellulose having a weight average molecular weight ranging from 26,000 to 63,000, a degree of polymerization ranging from 140 to 340, viscosity a (2% aqueous solution) ranging from 8 to 120 cps. and added in an amount ranging from 40 to 70% by weight based on the total solids weight.

A preferable formula of a heat sensitive coating composition is as shown below:

	% by weight
Heat sensitive color forming ingredients (for example, compound A and compound B in prior art, infra)	2 - 7
Inhibitor	0.5- 5
Melting material	0 - 5
Binder (acetylcellulose or methyl cellulose)	5 -15
Solvent	70 -90

The solvent used in the present invention may be water or an organic solvent. Representative organic solvents are alcohols such as methyl alcohol, ethyl alcohol, and isopropyl alcohol, ketones such as acetone and methylethyl ketone, esters such as ethyl acetate, aliphatic hydrocarbons such as hexane, heptane and petroleum benzine, halogen compounds such as methylene chloride and benzylchloride and aromatic hydrocarbons such as benzene, toluene and xylene.

As heat sensitive compositions, conventional heat sensitive compositions may be used, for example, the heat sensitive compositions disclosed in U.S. Pat. No. 3,442,682 and in U.S. Ser. No. 191,773 filed Oct. 22, 1971.

Further there may be used a two component heat sensitive composition in which one component (component A) contains an iron salt of an aliphatic acid and

the other component (component B) contains a compound selected from the class of gallic acid and its derivatives. The component A is reacted with the component B in the presence of an inhibitor of unusual color-development to produce a black color which can then be utilized as a recording image. The preferred iron salts of the aliphatic acid are the ferrous and ferric salts of aliphatic acids containing from about 8 to 24 carbon atoms. These aliphatic carboxylic acid include lauric acid, caprylic acid, pelargonic acid, capric acid and the like. The inhibitor of unusual color-development includes ethylenediamine tetracetic acid and alkali metal salts thereof. The aforementioned solvents can be used as a solvent for both of the components A and B.

FIGS. 1 and 2 are side and top views of the printing head after printing about 20 million letters by using a conventional heat-sensitive recording sheet, indicating that a coating composition (hatched portion) 1 flaked and scratched from the support adheres on the surfaces of mesa 2 and moat 3 of a printing head 4.

FIGS. 3 and 4 are top and side views of a printing head 4 after printing about twenty million letters by using the heat-sensitive sheet of this invention, indicating that the head is clear in both of the surfaces of mesa 2 and moat 3.

With the use of a conventional heat-sensitive sheet, the coating substance adheres to the surfaces of the mesa and the moat. The coating substance thus adhered produces incomplete printing and a blurred image.

The following examples will serve to illustrate but not to limit the invention. In the following examples, all parts are by weight.

EXAMPLE I

Formula for suspension component A:	
Ferric palmitate	3 parts
Behenic acid	8 parts
Acetylcellulose (mp. 230°C)	10 parts
Acetone	60 parts
Isopropylalcohol	10 parts
Methylalcohol	10 parts
Formula for suspension component B:	
5-Chloro-7-iodo-8-hydroxyquinoline	3 parts
EDTA	4 parts
Acetylcellulose (mp. 230°C)	10 parts
Acetone	60 parts
Isopropylalcohol	10 parts
Methylalcohol	10 parts

Each of the above-mentioned two compositions was prepared in a ball-mill. The resulting suspension liquids A and B were mixed by an agitator to form a homogeneous liquid coating agent, applied to a white paper to form a coating of 5 μ in thickness, and dried at room temperature to form a heat sensitive recording sheet.

Thermal printing was carried out on the resulting recording sheet up to 20 million letters using a thermal printer having a dot matrix type heat element (contact time of 15 milli-seconds) at a surface temperature of 150° - 180°C.

Neither flaking of the coating agent from the paper, nor adhesion on the heat element were observed.

Clear and uniform printing was obtained during the entire printing process.

EXAMPLE II

Formula for suspension component A:	
Diphenylcarbazine	1.9 parts
Tartaric acid	0.5 parts
Sodium citrate	0.9 parts
Stearic acid	1.9 parts
Acetylcellulose (mp. 230°C)	4.2 parts
Methylethylketone	30 parts
Isopropylalcohol	10 parts
Methylalcohol	5 parts
Formula for suspension component B:	
Mercuric behenate	3.6 parts
Acetylcellulose (mp. 230°C)	4.2 parts
Methylethylketone	30 parts
Isopropylalcohol	10 parts
Methylalcohol	5 parts

The above-mentioned two compositions were treated in the same manner as in Example 1 to produce a recording sheet. Following the procedure of Example 1, the similar good results were obtained.

Other than acetylcellulose, methylcellulose can be used in this Example. In this case, a mixture of water and methylalcohol may be used as a solvent.

EXAMPLE III

Formula for suspension component A:	
Ferric stearate	5 parts
EDTA	1 part
Acetylcellulose	8 parts
Acetone	60 parts
Methylalcohol	10 parts
Isopropylalcohol	10 parts
Formula for suspension component B:	
Lauryl gallate	5 parts
EDTA	1 part
Acetylcellulose	8 parts
Acetone	60 parts
Methylalcohol	10 parts
Isopropylalcohol	10 parts

The above-mentioned two compositions were treated in the same manner as in Example 1 to produce a recording sheet.

Following a similar test printing as in Example 1, similarly good results were obtained.

We claim:

1. In a thermal printing process for forming an image on a heat-sensitive recording sheet composed of a support having superposed thereon a heat-sensitive layer which is composed of a heat-sensitive composition dispersed in a binder therefor, said process comprising contacting a thermally-heated print head with the surface of the heat-sensitive layer to form a printed image thereon, the improvement comprising eliminating exfoliation of the heat-sensitive layer from the support by employing, as the binder, a member selected from the group consisting of methyl cellulose and acetylcellulose having a melting point of not lower than 180°C.

2. The process of claim 1 wherein the binder is acetylcellulose having a weight average molecular weight from 28,000 to 58,000, a degree of polymerization from 175 to 360 and a viscosity from 10 to 40 seconds based on ASTM E standard at 20% concentration.

3. The process of claim 1 wherein the binder is methyl cellulose having a weight average molecular weight from 26,000 to 63,000, a degree of polymerization from 140 to 340 and a viscosity from 8 to 120 cps at 2% aqueous solution.

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