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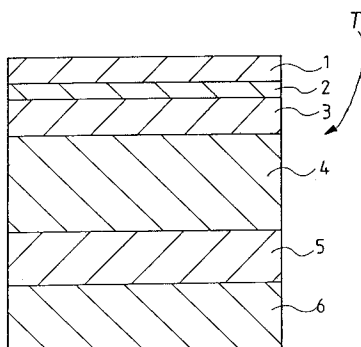
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(54) **Printing tape and printing-tape cartridge.**

(57) Disclosed is a printing tape T having a support sheet 4, a heat-sensitive layer 3 including thermal chromogenic material formed on one surface of the support sheet 4, a colored transparent layer 2 including colorant formed on the heat-sensitive layer 3, a transparent protection layer 1 which is mainly formed of silicone resin curable at ordinary temperature. On the other surface of the support sheet 4, a removable sheet 6 is adhered through an adhesive layer 5. And a printing-tape cartridge C that a tape spool 10 around which the printing tape T mentioned above is wound is rotatably supported in a housing 11, is disclosed. When images such as characters are recorded on the printing tape T, the printing-tape cartridge C is set in a printer 20 having a thermal head 15 and the images are recorded on the printing tape T by the thermal head 15 while being derived from the tape spool 10.

FIG. 1

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BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates to a printing tape having a heat-sensitive layer or thermal chromogenic layer formed on a support sheet, through which images such as characters are printed thereon by being heated through a thermal head. In particular, the present invention relates to a printing tape having a colored transparent layer, on the heat-sensitive layer, defining background color of the printing tape and a transparent protection layer on the colored transparent layer, thereby the images imprinted in the heat-sensitive layer by the thermal head can be clearly recognized in the background color. And the present invention relates to a printing tape with superior light fastness and solvent resistance through which abrasion of the thermal head can be prevented and life thereof can be lengthened. Further, the present invention relates to a printing-tape cassette or cartridge accommodating the above printing tapes, which is utilized in a tape printer.

2. Description of Related Art

Conventionally, there have been proposed various printing tapes. These kinds of printing tapes are generally produced by forming a heat-sensitive or thermal chromogenic layer on a film-like support sheet. Here, for instance, in order to form the heat-sensitive or thermal chromogenic layer, a mixture of leuco-dye such as crystal violet lactone (CVL), which is disclosed in the specifications of U.S. Patent Nos. 2,712,507 and 2,730,457, and organic acid such as phenol compound, is used.

The heat-sensitive layer includes a chromogenic material which is colored by being heated through the thermal head, thereby the images such as characters are formed on the printing tape.

25 On the surface of the heat-sensitive or thermal chromogenic layer, a protection layer for protecting the heat-sensitive or thermal chromogenic layer is formed and the protection layer is made transparent so that colored portions (i.e. images such as characters) can be visually recognized through the protection layer.

Further, on the surface of the support sheet opposite to the surface where the heat-sensitive or thermal chromogenic layer is formed, a colored layer is formed by coating print ink, which includes pigments or dyes, so that the images formed in the heat-sensitive or thermal chromogenic layer can be recognized in the background color defined by the colored layer. At that time, the background color of the colored layer is visually recognized through the support sheet, the heat-sensitive or thermal chromogenic layer and the protection layer.

35 In the thus produced printing tape, the heat-sensitive or thermal chromogenic layer is colored by being heated through a thermal head, thereby the image such as characters are formed in the background color defined by the colored layer, on the printing tape. And, in general, the printing tape is utilized in a tape printer in a state that the printing tape is accommodated in a printing-tape cartridge. In the case that printing of the images is conducted on the printing tape through the thermal head arranged in the tape printer, the heat-sensitive or thermal chromogenic layer is heated by the thermal head while both the thermal head and the printing tape are relatively moved. Thereby, the images such as characters are printed on the printing tape.

45 Here, the thermal head conducts thermal printing of the images while contacting with the printing tape (during relative movement of the thermal head), therefore it occurs trouble in printing if the thermal head is not smoothly moved. To improve this problem, it is conventionally proposed a printing tape in which a lubricant layer composed of fine particles of calcium oxide dispersed in water-soluble resin such as polyvinyl alcohol is formed on the heat-sensitive layer, so as to smoothly move the thermal head. In printing, the thermal head is smoothly and relatively moved while contacting with the lubricant layer of the printing tape.

50 However, the heat-sensitive or thermal chromogenic layer formed from the mixture mentioned above is generally translucent and it is very difficult to make the heat-sensitive or thermal chromogenic layer transparent. Therefore, the background color of the colored layer recognized through the translucent chromogenic layer becomes blurred and whitened color, due to translucency of the heat-sensitive or thermal chromogenic layer such as frosted glass. As a result, inherent color of pigments or dyes in the colored layer cannot be seen. Clearly from the above, unless the support sheet, the heat-sensitive or thermal chromogenic layer and the protection layer are transparent, the background color of the colored layer cannot be recognized therethrough, so long as the colored layer is formed on the surface of the support sheet opposite to the surface where the heat-sensitive or thermal chromogenic layer is formed.

And in the above printing tape having the lubricant layer, such lubricant layer is formed of fine particles of calcium oxide dispersed in water-soluble resin such as polyvinyl alcohol, so as to smoothly move the thermal head. In this case, the fine particles included in the lubricant layer are apt to be exposed on the surface of the lubricant layer while the thermal head relatively moves on the lubricant layer. Thus, there is a problem that the surface of the thermal head is shaved and reduced by the fine particles exposed on the lubricant layer. As a result, the surface of the thermal head is abraded while repeating printing operation by using such printing tape, thereby life of the thermal head is remarkably shortened.

Further, the heat-sensitive layer on the printing tape is inferior in light fastness. Thus, the heat-sensitive layer is discolored in yellow while being exposed in light (in particular, ultraviolet rays) and fading (discoloring) in the images formed on the heat-sensitive layer occurs, therefore the printed tape on which the images are recorded cannot be conserved for long time.

In addition, the heat-sensitive layer is inferior in chemical resistance and, for example, the heat-sensitive layer is colored by contacting with alcohol and is faded or discolored by contacting with interfacial active agent, oil, plasticizer, thereby non-colored portion in the heat-sensitive layer cannot form the images.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a printing tape through which images such as characters can be clearly formed thereon in background color defined by a colored transparent layer formed on a heat-sensitive or thermal chromogenic layer on a support sheet in case that the support sheet and the heat-sensitive layer are not transparent. And it is an another object of the present invention to provide a printing tape having both superior light fastness and chemical resistance, through which a thermal head can record the images thereon while smoothly and relatively moving therewith, and life of the thermal head can be lengthened without abrasion of the thermal head in spite of relative movement, when the images such as characters are recorded on the printing tape by relatively moving the thermal head on the printing tape.

Further, it is an another object of the present invention to provide printing-tape cartridges which accommodate such printing tapes as indicated above.

In order to accomplish the above-indicated objects, according to a first aspect of the present invention, it is provided a printing tape having a support sheet, a heat-sensitive layer formed on one surface of the support sheet and a transparent protection layer formed on the heat-sensitive layer, the printing tape being used for a tape-recording printer including a thermal head which thermally records images on the printing tape, the printing tape comprising :

a colored transparent layer which includes colorant, the colored transparent layer being formed between the heat-sensitive layer and the protection layer.

In the printing tape of the present invention, the colored transparent layer is formed between the heat-sensitive layer and the protection layer and the colorant in the colored transparent layer determines a background color of the printing tape. Therefore, the images recorded on the printing tape can be clearly recognized in the background color determined through the colored transparent layer, in case that both the support sheet and the heat-sensitive layer are not transparent. As a result, based on that it is not necessary that the support sheet and the heat-sensitive layer are transparent, materials for forming the support sheet and the heat-sensitive layer can be freely selected, thus the materials utilizable for the support sheet and the heat-sensitive layer are increased.

And according to a second aspect of the present invention, it is provided a printing-tape cartridge accommodating a printing tape, for use with a tape-recording printer including a thermal head which thermally records images on the printing tape, the printing-tape cartridge comprising :

a housing;

a tape spool disposed inside the housing so that the tape spool is rotatable, the printing tape being wound around the tape spool;

wherein the printing tape comprises a support sheet, a heat-sensitive layer formed on one surface of the support sheet, a colored transparent layer including colorant formed on the heat-sensitive layer and a transparent protection layer formed on the colored transparent layer, the protection layer being mainly formed of resin curable at ordinary temperature.

In the printing-tape cartridge of the present invention, when the images are recorded on the printing tape by the thermal head arranged in the tape-recording printer, the printing tape is derived from the tape spool rotatably disposed in the housing of the printing-tape cartridge and the images are thermally recorded on the printing tape by the thermal head. At that time, similarly to the above, the colored transparent layer is formed between the heat-sensitive layer and the protection layer and the colorant in the colored

transparent layer determines a background color of the printing tape. Therefore, the images recorded on the printing tape can be clearly recognized in the background color determined through the colored transparent layer, in case that both the support sheet and the heat-sensitive layer are not transparent. As a result, based on that it is not necessary that the support sheet and the heat-sensitive layer are transparent, materials for forming the support sheet and the heat-sensitive layer can be freely selected, thus the materials utilizable for the support sheet and the heat-sensitive layer are increased.

Further, according to a third aspect of the present invention, it is provided a printing tape having a support sheet, a heat-sensitive layer formed on one surface of the support sheet and a protection layer formed on the heat-sensitive layer, the printing tape being used for a tape-recording printer including a thermal head which thermally records images on the printing tape through the heat-sensitive layer,

wherein the protection layer is mainly formed of silicone resin curable at ordinary temperature and includes ultraviolet absorbing agent.

In the printing tape of the present invention, when printing of the images is conducted, the thermal head of the tape-recording printer is relatively moved on the protection layer, which is mainly composed of the silicone resin curable at ordinary temperature, formed on the topmost surface of the printing tape, while contacting with the protection layer. During printing of the images, the heat-sensitive layer formed on the support sheet is colored by the thermal head, thereby the images such as characters are recorded on the heat-sensitive layer. At that time, since the protection layer which is composed of the silicone resin curable at ordinary temperature is formed on the heat-sensitive layer, the thermal head can be smoothly and relatively moved on the protection layer based on good slidability, heat resistance and flexibility given to the protection layer. And the ultraviolet absorbing agent is included in the protection layer, thus ultraviolet rays are absorbed by the protection layer. Therefore, it can be realized the printing tape having a superior light fastness.

And further, according to a fourth aspect of the present invention, it is provided a printing-tape cartridge accommodating a printing tape, for use with a tape-recording printer including a thermal head which thermally records images on the printing tape, the printing-tape cartridge comprising :

a housing;

a tape spool disposed inside the housing so that the tape spool is rotatable, the printing tape being wound around the tape spool;

wherein the printing tape comprises a support sheet, a heat-sensitive layer formed on one surface of the support sheet, a barrier layer formed on the heat-sensitive layer and a protection layer formed on the barrier layer, the protection layer being mainly formed of resin curable at ordinary temperature.

In the printing-tape cartridge of the present invention, when the images are recorded on the printing tape by the thermal head arranged in the tape-recording printer, the printing tape is derived from the tape spool rotatably disposed in the housing of the printing-tape cartridge and the images are thermally recorded on the printing tape by the thermal head. At that time, similarly to the above, since the protection layer which is composed of the silicone resin curable at ordinary temperature is formed on the heat-sensitive layer, the thermal head can be smoothly and relatively moved on the protection layer based on good slidability, heat resistance and flexibility given to the protection layer. And the ultraviolet absorbing agent is included in the protection layer, thus ultraviolet rays are absorbed by the protection layer. Therefore, it can be realized the printing-tape cartridge accommodating the printing tape having a superior light fastness.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for purpose of illustration only and not intended as a definition of the limits of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with reference to the following drawings, wherein :

Fig. 1 is a schematic sectional view of a printing tape according to the first embodiment of the present invention ;

Fig. 2 is a plan view of a lower half housing of a tape cartridge in which the printing tape of the first embodiment is accommodated ;

Fig. 3 is a perspective view of a tape printer in which the tape cartridge is utilized ;

Fig. 4 is a schematic sectional view of a printing tape according to the second embodiment of the present invention ;

Fig. 5 is a plan view of a lower half housing of a tape cartridge in which the printing tape of the second embodiment is accommodated ;

Fig. 6 is a graph indicating measurement results of optical densities in printed portion and non-printed portion, which exist in a printed sample prepared by using the printing tape of the second embodiment and in a comparison printed sample prepared by using a comparison printing tape, respectively ;

Fig. 7 is a side view of a thermal head ; and

5 Fig. 8 is a table indicating change of abrasion amount in the thermal head when printing test is conducted.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 A detailed description of the preferred first embodiment of a printing tape embodying the present invention will be given referring to the accompanying drawings.

Referring to Fig. 1, there is schematically shown a printing tape according to the first embodiment. In the printing tape T, a removable sheet 6 is adhered onto one surface of a support sheet 4 (lower surface of the support sheet 4 in Fig. 1), through an adhesive layer 5. And onto the other surface of the support sheet
15 4 (upper surface of the support sheet 4 in Fig. 1), a heat- sensitive or thermal chromogenic layer 3 is formed. Further, on the heat-sensitive or thermal chromogenic layer 3, a colored transparent layer 2 in which pigments are dispersed or dyes are dissolved is formed. And on the colored transparent layer 2, a transparent protection layer 1 is formed, the protection layer 1 being mainly composed of resin curable or hardenable at ordinary (room) temperature, in which ultraviolet absorbing agent is dispersed or dissolved.

20 Here, the heat-sensitive or thermal chromogenic layer 3 is formed of a composition containing a leuco-dye ; a color developer, which reacts, when being heated, with the leuco-dye to develop a color from the dye ; a reaction promoter which promotes the reaction of the leuco-dye and the developer ; and a binder which binds the leuco-dye and the developer. The thermally chromogenic composition may further contain a pigment and/or an auxiliary agent (described hereinafter).

25 The leuco-dye suitable for the thermal chromogenic layer 3 is preferably selected from the leuco-dyes which are colorless or hypochromic, as follows.

(a) triphenylmethane dyes such as ;

3,3-bis(p-dimethylaminophenyl) phthalide,

3,3-bis(p-dimethylaminophenyl) -6-dimethylaminophthalide, (also referred to as Crystal Violet lactone)

30 3,3-bis(p-dimethylaminophenyl) -6-chlorophthalide, and

3,3-bis(p- dibutylaminophenyl) phthalide, (also referred to as Malachite Green lactone),

(b) fluoran dyes such as

3-dimethylamino-6-methoxyfluoran,

3-dimethylamino-6-methyl-7-chlorofluoran,

35 3-dimethylamino-5-methyl -7-dibenzylaminofluoran,

3-diethylamino-7-chlorofluoran,

3-diethylamino-7-methoxyfluoran,

3-diethylamino-7-methylaminofluoran,

40 3-diethylamino-7-(N-methylanilino)fluoran,

3-diethylamino-7-ortho-chloroanilinofluoran,

3-diethylamino-7-(3-fluoromethyl)phenylaminofluoran,

3-diethylamino-7,8-benzofluoran,

3-diethylamino-6-methyl-7-chlorofluoran,

45 3-diethylamino-6-methyl-7-anilinofluoran,

3-diethylamino-6-methyl-7-p-butylanilinofluoran,

3-diethylamino-5-methyl-7- dibenzylaminofluoran,

3-morpholino-5,6-benzofluoran,

3-ethyl-6-diethylaminofluoran,

50 2-anilino-6-diethylaminofluoran,

3-(N-methyl-N-cyclohexylamino)-6-methyl-7-anilinofluoran, and

3-(N-p-tolyl-N-ethylamino)-6-methyl-7-(N-phenylamino)fluoran,

(c) phenothiazine dyes such as benzoyl Leucomethylene Blue, 2,2-dimethyl Leucomethylene Blue,

p-anisoyl Leucomethylene Blue, and

55 N-pivalyl Leucomethylene Blue,

(d) Rhodamine lactam dyes such as N-phenyl Rhodamine β lactam, and acid Rhodamine β sulton, and

(e) spiropyran dyes such as benzo- β -naphthospiropyran, and 1,3,3-trimethyl-6'-chloro-8'-methoxy-indolinobenzospiropyran. In addition to the above, it is utilizable 2-[3,6-bis(diethylamino)-9-(o-chloroanilino) xanthy] and benzoic lactam.

The color developer suitable for the thermal chromogenic layer 3 is preferably selected from phenolic compounds which liquefy or gasify at temperatures higher than room temperature so as to react with the above-described leuco-dye and thereby develop a color from the dye. The phenolic compounds preferably used in the present invention are as follows:

4,4'-isopropylidenediphenol,
4,4'-isopropylidenebis(2-chlorophenol),
4,4'-isopropylidenebis(2-methylphenol),
4,4'-isopropylidenebis(2-tert-butylphenol),
4,4'-sec-butylidenediphenol,
4,4'-cyclohexylidenediphenol,
4-tert-butylphenol,
4-tert-octylphenol,
4-tert-octylcatechol,
4-phenylphenol (i.e., p-phenylphenol)
4-hydroxy diphenoxide,
2,2-bis(p-hydroxyphenyl)propane (i.e., bisphenol A),
2,2-bis(p-hydroxyphenyl)buthane,
2,2-bis(2,5-dibrom-4-hydroxyphenyl)propane,
2,2'-dihydroxydiphenol,
2,2'-methylenebis(4-chlorophenol),
 α -naphthol,
 β -naphthol,
methyl-4-hydroxybenzoate,
benzyl-4-hydroxybenzoate,
ethyl-4-hydroxybenzoate,
propyl-4-hydroxybenzoate,
4-hydroxy-acetophenone,
novolak phenolic resins,
halogenated novolak phenolic resins,
other phenilic resins,
benzoic acid,
salicylic acid,
tartaric acid,
gellic acid.

The reaction promoter suitable for the thermal chromogenic layer 3 is preferably selected from stearic acid amide, methylenebis(stearic acid amide), oleic acid amide, palmitic acid amide, sperm-whale oleic acid amide, coconut fatty acid amide, etc.

The binder suitable for the thermal chromogenic layer 3 is preferably selected from water-soluble polymer such as polyvinyl alcohol, starch, denatured starch, derivatives of starch, methyl cellulose, hydroxyethyl cellulose, carboxymethyl cellulose, gum arabic, gelatin, casein, polyvinyl pyrrolidone, polyacrylamide, salt of polyacrylic acid, styrene/butadien copolymer, polyvinyl acetate, ester of polyacrylic acid, or water emulsion of polymer such as polystyrene, polyvinyl chloride/polyvinyl acetate copolymer, polybutyl methacrylate.

The composition used for forming the thermal chromogenic layer 3 may further contain a white pigment such as talc, clay, silica, titanium oxide, or ureaformaldehyde resin; and/or an auxiliary agent such as various waxes, metallic salt of higher fatty acid, higher fatty acid amide, dispersant, lubricant, or anti-foamer. Here, the thermal chromogenic layer 3 is preferably coated and formed on the support sheet 4 with a thickness in a range of 2 ~ 20 g/ m², especially 5 ~ 10 g/ m², after being fully dried.

The colored transparent layer 2 is provided over the thermal chromogenic layer 3 to protect the thermal chromogenic layer 3 so that the thermal chromogenic layer 3 is not invaded by the solvent included in the solution of silicone resin which is curable at ordinary (room) temperature (later mentioned). The colored transparent layer 2 is preferably formed of various water-soluble resins which have film-forming ability. Such water-soluble resin is preferably selected from polyvinyl alcohol, methyl cellulose, ethyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyacrylamide, starch, gelatin, polyvinyl pyrrolidone, or methoxy cellulose. And the colored transparent layer 2 is formed of mixture including such one or two water-soluble

resins selected from the above.

For protecting the thermal chromogenic layer 3 against water or moisture, the colored transparent layer 2 further contains an anti-water agent such as formalin, glyoxal, chrome alum, melamine, melamine formalin, polyamide resin, or polyamide epichlorhydrin resin. Here, the colored transparent layer 2 is preferably coated and formed on the chromogenic layer 3 with a thickness in a range of 0.5 ~ 10 g/ m², especially 1 ~ 5 g/ m², after being fully dried.

For the pigment dispersed in the colored transparent layer 2, it is preferable the organic pigment or inorganic pigment used in ordinary print ink, the surface of the pigment being treated so that the pigment is easily dispersed in the resin.

And for the dye dispersed in the colored transparent layer 2, it is preferably selected from xanthene dye, coumalin dye, merocyanine dye, thiazine dye, azine dye, methine dye, oxazine dye, phenylmethane dye, cyanin dye, azo dye, anthraquinone dye, pyrazoline dye, stilbene dye, or quinoline dye.

The protection layer 1 formed on the colored transparent layer 2 is mainly formed of the silicone resin which is curable at ordinary temperature, the silicone resin being utilizable in solvent system, water system or ultraviolet curable resin system. Preferably for the protection layer 1, it is utilizable the silicone resin or the urethane resin which are curable at ordinary temperature. For instance, as the silicone resin curable at ordinary temperature, resin silicone or rubber silicone curable at room temperature can be used. Concretely, various silicone coating agents (for instance, SR2410, SR2411, SE5060, SE5070, SE1980 from Toray Dow Corning Silicone Co.Ltd.) are available for the protection layer 1.

For the ultraviolet absorbing agent, it is preferably selected from derivatives of benzotriazole such as :

2-(5-methyl-2-hydroxyphenyl)benzotriazole,
2-[2-hydroxy-3,5-bis(α , α '-dimethylbenzyl) phenyl]-2H-benzotriazole,
2-(3,5-di-t-butyl-5-methyl-2-hydroxyphenyl)benzotriazole,
2-(3,5-t-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole,
2-(3,5-di-t-butyl-2-hydroxyphenyl)-5-chlorobenzotriazole, and
2-(3,5-di-t-amyl-2-hydroxyphenyl)benzotriazole.

For the support sheet 4 of the printing tape T, it is preferably selected from plastic films such as polyethylene film, polyamide film, polyester film, polypropylene film, polyvinylchloride film or papers such as craft paper, Japanese paper.

The adhesive used for forming the adhesive layer 5 is preferably selected from solvent-type acrylic adhesives, rubber adhesives, water-soluble adhesives, hot-melt adhesives, and emulsion-type adhesives. The removable sheet 6 is preferably produced by coating with silicone or polyethylene, opposite surfaces of a glassine paper, craft paper or polyethylene terephthalate (PET).

[Production of Printing Tape T]

For producing printing tape T, first, a first disperse system is prepared in which a leuco-dye and a binder are dispersed, and a second disperse system is prepared in which a color developer and the same binder are dispersed. The first and second disperse systems are mixed with each other, and are agitated to provide a coating material for forming the thermal chromogenic layer 3. The coating material is applied, by using a coating device such as a bar, air knife, comma coater, reverse roll, or gravure roll, to one surface of the support sheet 4. Subsequently, the applied material is dried by being subjected to hot air, so that the chromogenic layer 3 is formed on the support sheet 4.

After the thermal chromogenic layer 3 is formed, a coating material including dispersed pigment or dissolved dye for forming the colored transparent layer 2 is applied onto the chromogenic layer 3 by the same coating device and the material is dried by being subjected to hot air, thereby the colored transparent layer 2 is formed on the chromogenic layer 3. At that time, the colored transparent layer 2 acts for protecting the thermal chromogenic layer 3 against the solvent in the resin solution including the resin curable at ordinary temperature, if it is conceivable that the solvent included in the resin solution for forming the protection layer 1 affects the chromogenic layer 3. Thereafter, the resin solution of the resin curable at ordinary temperature, in which the ultraviolet absorbing agent dispersed or dissolved, for forming the protection layer 1 is applied onto the protection layer 2. And after the resin solution is dried, the protection layer 1 is formed. Further, the removable sheet 6, on one surface of which the adhesive layer 5 is coated, is adhered onto the opposite surface of the support sheet 4 through the adhesive layer 5. Thereby, the printing tape T is produced.

Next, an example of the concrete manner for producing the printing tape T will be detailedly described hereinafter.

[Example]

(a) Support Sheet 4

5 As the support sheet 4, a polyester film (CRISPER from Toyobo Co.Ltd.) with 38 μm thickness is prepared.

(b) Preparation Of Material For Thermal Chromogenic Layer 3

10 For preparing the coating material for forming the thermal chromogenic layer 3, first, a liquid A and a liquid B are prepared which have the following composition, respectively.

Liquid A	(parts by weight)
1. Leuco-dye crystal violet lactone 2. Binder 20 % aqueous solution of polyvinyl alcohol 3. Water	15 50 435
Liquid B	
1. Color developer bisphenol A 2. Reaction promoter stearic acid amide 3. Binder 20 % aqueous solution of polyvinyl alcohol 4. Calcium carbonate 5. Water	60 10 100 30 300

After the liquids A and B are prepared, each of the two liquids is homogenized using a ball mill, separately from each other, for twenty four hours. Subsequently, the liquids A, B are mixed with each other and sufficiently agitated to provide the coating material for forming the thermal chromogenic layer 3.

30 (c) Application Of The Coating Material

The thus obtained coating material is applied using a gravure roll to one of opposite major surfaces of the support sheet 4, to a thickness of 5 g/ m^2 after being dried. The applied material is dried into the thermal chromogenic layer 3 on the support sheet 4.

(d) Production Of The Colored Transparent Layer 2

As a pre-treatment for forming the protection layer 1 mainly composed of silicone resin on the thermal chromogenic layer 3, aqueous solutions, each of which includes 20 % of polyvinyl alcohol (produced by Kuraray Co. Ltd., Japan), 20% of denatured NBR (nitril•butadiene rubber produced by Takeda Chemical Industries Co. Ltd.) and 20% of acryl emulsion with self-crosslinking ability (produced by Rohm Co. Ltd.), is prepared, respectively. Thereafter, 5 weight parts of the dye (R-305 produced by Nippon Kayaku Co. Ltd.) is dissolved in the polyvinyl alcohol solution. And mixed solution, in which the polyvinyl alcohol solution, the denatured NBR solution and the acryl emulsion solution are equivalently mixed, is prepared. Thereafter, the thus mixed solution is coated on the thermal chromogenic layer 3 through the gravure roll, to a thickness of 2 g/ m^2 after being dried, thereby the colored transparent layer 2 is formed on the chromogenic layer 3. The thus formed colored transparent layer 2 has a color defined by the dye contained therein.

50 (e) Production Of The Protection Layer 1

First, to form the protection layer 1, urethane resin solution in which silicone resin is mixed is prepared according to the following composition.

	[Urethane resin solution]	(parts by weight)
5	1. Polyurethane (UA-90 produced by Sanyo Chemical Industries Co.Ltd.)	100
	2. Polyurethane crosslinking agent (SCAT-24 produced by Sanyo Chemical Industries Co.Ltd.)	1
	3. Silicone resin curable at ordinary temperature (SR2411 produced by Toray Dow Corning Silicone Co. Ltd.)	30
10	4. Ultraviolet absorbing agent (2-(5-methyl-2-hydroxyphenyl)benzotriazole)	3
	5. Toluene	100

15 The above compounds are mixed and agitated, thereby the urethane resin solution is prepared. Thereafter, the urethane resin solution is coated through the gravure roll on the colored transparent layer 2, to a thickness of 2 g/ m² after being dried. Thereby, the protection layer 1 is formed on the colored transparent layer 2 by drying. Here, the protection layer 1 is transparent without color.

(f) Preparation Of The Removable Sheet 6

20 First, an adhesive is prepared which has the following composition:

	[Adhesive]	(parts by weight)
25	1. Oil and fat (Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	100
	2. Isocyanate-type hardener (B-45 from Ipposha Oil Industries Co. Ltd., Japan)	2
	3. Ethyl acetate	30

30 The above compounds are mixed and agitated to provide an adhesive, which is then applied using a comma coater to one of opposite major surfaces of the removable sheet 6 formed of a 60 μm thick paper (70XT-032B from Fujimori Kogyo Co Ltd., Japan) whose surfaces have been coated with silicone. Thus, the adhesive layer 5 is formed on the removable sheet 6, to a thickness of 20 g/ m² after sufficiently being dried.

35 (g) Production Of Printing Tape T

The thus prepared removable sheet 6 is adhered on the surface of the support sheet 4, opposite to the surface where the thermal chromogenic layer 3, the colored transparent layer 2 and the protection layer 1 are formed. Thereby, the printing tape T is produced.

40 [Production Of Printed Tape]

Hereinafter, by reference to Figs. 2 and 3, there will be described the manner of production of printed tape by using the printing tape T. Here, Fig. 2 is a plan view of a lower half housing of a tape cartridge, with an upper half of housing (not shown) being removed and Fig. 3 is a perspective view of a tape printer which includes a thermal head for thermally recording images on the printing tape T.

First, the printing tape T as described above is cut into 12 mm width web before the printing tape T is arranged in the cartridge C. Subsequently, the thus obtained printing tape T is wound around a tape spool 10 having a 12 mm outer diameter and a 12 mm height, such that the removable sheet 6 is located outside. The tape spool 10 is accommodated in the lower housing 11, as shown in Fig. 2, such that the tape spool 10 is rotatably supported by the lower housing and the upper housing (not shown).

55 In the lower housing 11, the printing tape T is fed from the tape spool 10 to a printing section 13 via a tape guide member 12. The feeding of the printing tape T is effected by a tape feed roller 14 which is driven, when the cartridge C is set in the printer 20, by a tape feed shaft 21 of the printer 20. With the cartridge C being set in the printer 20, the thermal head 15 of the printer 20 is positioned in the printing section 13. The thermal head 15 is fixedly disposed in a cartridge receiving area 22 of the printer 20, and has a plurality of heat generating elements vertically arranged in an array. In addition, the printer 20 has a roller support member 16 which is disposed opposite to the thermal head 15 such that the roller support

member 16 is pivotable about an axis member 19 fixed to the printer 20.

A platen roller 17 and a presser roller 18 are rotatably supported by the roller support member 16. When the thermal head 15 records characters and/or other images on the printing tape T, the roller support member 16 is rotated counterclockwise about the axis member 19. Thus, the platen roller 17 is pressed
 5 against the thermal head 15, so that the thermal head 15 can record with stability images in the thermal chromogenic layer 3 of the printing tape T. Concurrently, the presser roller 18 is pressed against the tape feed roller 14 of the cartridge C, so that the two rollers 18, 14 cooperate with each other to feed the thus printed length of the printing tape T out of the cartridge C.

The tape cartridge C is inserted in the tape receiving area 22 provided in a rear section (in the right-hand portion as seen in Fig. 3) of the printer 20. Electric current is selectively applied to the individual heat generating elements of the thermal head 15, so that the thermal head 15 heats selected areas of the thermal chromogenic layer 3 of the printing tape T. The chromogenic material reacts with the color developer and thereby develops color, in the heated areas of the chromogenic layer 3. Thus, the desired
 10 images such as characters are imprinted in the chromogenic layer 3 of the printing tape T.

Thereafter, the printing tape T on which the images are imprinted is fed out of the tape cartridge C through cooperation of the tape feed roller 14 and the presser roller 18. And the fed out printing tape T is cut out by a cutter, and the thus cut out printing tape T becomes the printed tape.

The printed tape, which is produced by imprinting the images in the chromogenic layer 3 of the printing tape T through the tape printer 20, can be adhered on an object through adherent force of the adhesive layer 5 after the removable sheet 6 is peeled.
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As mentioned above, in the printing tape T of the first embodiment embodying the present invention, the colored transparent layer 2 containing the pigments or dyes is formed on the thermal chromogenic layer 3 which is formed on one surface of the support sheet 4 and the protection layer 1 mainly composed of the resin curable at ordinary temperature containing the ultraviolet absorbing agent therein is formed on the colored transparent layer 2. Therefore, the images such as characters imprinted in the chromogenic layer 3 while printing thereof can be clearly recognized through only the transparent protection layer 1 in the background color defined by the colored transparent layer 2 in which the color of the pigment or dye directly reproduced.
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Thus, since the background color of the images such as characters in printed tape is defined by the color of the colored transparent layer 1 which is formed on the thermal chromogenic layer 3, it is not necessary that the thermal chromogenic layer 3 is transparent, thereby the materials used for the dye, the color developer, the reaction promoter and the binder for forming the thermal chromogenic layer 3 can be freely selected. As a result, the materials utilizable for forming the chromogenic layer 3 are increased. Further, similar to the thermal chromogenic layer 3, since it is not necessary that the support sheet 4 is transparent, the materials used for the support sheet 4 can be freely selected, thereby the materials
 30 utilizable for the support sheet 4 are increased.

And in the printing tape T, the colored transparent layer 2 is formed between the thermal chromogenic layer 3 and the protection layer 1, therefore it can prevent the solvent included in the urethane resin solution for forming the protection layer 1 from affecting or invading the thermal chromogenic layer 3, when
 40 coating the urethane resin solution on the thermal chromogenic layer 3 to form the protection layer 1.

Further, the protection layer 1 is mainly formed of the silicone resin curable at ordinary temperature and the thermal head 15 of the printer 20 is relatively moved while contacting with the protection layer 1 when printing of the images is conducted. At that time, the thermal head 15 and the printing tape T are relatively and smoothly moved with each other through the protection layer 1 formed of the silicone resin. In addition,
 45 life of the thermal head 15 can be lengthened without defacing thereof.

And since the ultraviolet absorbing agent is included in the protection layer 1, not only the printed portion (where the images are formed) and the non-printed portion (which is not used for printing of the images) can be effectively protected from ultraviolet rays, but also it can prevent the non-printed portion from being discolored in yellow. Therefore, the printing tape T which is stably utilizable for long time without inferiority of the images can be obtained.
 50

And further, the adhesive layer 5 is exposed on the surface of the support sheet 4 opposite to the surface where the thermal chromogenic layer 3 is formed by peeling the removable sheet 6 from the printed tape, therefore the printed tape can be adhered on a surface of a desired object through adherent force of the adhesive layer 5.

Next, a printing tape according to the second embodiment of the present invention will be described with reference to Figs. 4 to 8. Here, the printing tape U in the second embodiment essentially has the same construction as the printing tape T in the first embodiment. That is to say, as shown in Fig. 4, in the printing tape U, a removable sheet 36 is adhered onto one surface of a support sheet 34 (lower surface of the
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support sheet 34 in Fig. 4), through an adhesive layer 35. And onto the other surface of the support sheet 34 (upper surface of the support sheet 34 in Fig. 4), a heat-sensitive or thermal chromogenic layer 33 is formed. Further, on the heat-sensitive or thermal chromogenic layer 33, a barrier layer 32 for protecting the heat-sensitive or thermal chromogenic layer 33 is formed. And on the barrier layer 32, a protection layer 31 is formed, the protection layer 31 being mainly composed of resin curable or hardenable at ordinary (room) temperature, in which ultraviolet absorbing agent is dispersed or dissolved.

In comparing the printing tape U with the printing tape T, the colored transparent layer 2 in the printing tape T of the first embodiment is substituted for the barrier layer 32 in the printing tape U.

Here, as same as in the printing tape T, the heat-sensitive or thermal chromogenic layer 33 is formed of a composition containing a leuco-dye ; a color developer, which reacts, when being heated, with the leuco-dye to develop a color from the dye ; a reaction promoter which promotes the reaction of the leuco-dye and the developer ; and a binder which binds the leuco-dye and the developer. The thermally chromogenic composition may further contain a pigment and/or an auxiliary agent (described hereinafter).

The leuco-dye suitable for the thermal chromogenic layer 33 is preferably selected from the leuco-dyes which are colorless or hypochromic, as follows.

(a) triphenylmethane dyes such as ;

3,3-bis(p-dimethylaminophenyl) phthalide,

3,3-bis(p-dimethylaminophenyl) -6-dimethylaminophthalide, (also referred to as Crystal Violet lactone)

3,3-bis(p-dimethylaminophenyl) -6-chlorophthalide, and

3,3-bis(p- dibutylaminophenyl) phthalide, (also referred to as Malachite Green lactone),

(b) fluoran dyes such as

3-dimethylamino-6-methoxyfluoran,

3-dimethylamino-6-methyl-7-chlorofluoran,

3-dimethylamino-5-methyl -7-dibenzylaminofluoran,

3-diethylamino-7-chlorofluoran,

3-diethylamino-7-methoxyfluoran,

3-diethylamino-7-methylaminofluoran,

3-diethylamino-7-dibenzylaminofluoran,

3-diethylamino-7-(N-methylanilino)fluoran,

3-diethylamino-7-ortho-chloroanilino-fluoran,

3-diethylamino-7-(3-fluoromethyl)phenylaminofluoran,

3-diethylamino-7,8-benzofluoran,

3-diethylamino-6-methyl-7-chlorofluoran,

3-diethylamino-6-methyl-7-anilino-fluoran,

3-diethylamino-6-methyl-7-p-butylanilino-fluoran,

3-diethylamino-5-methyl-7- dibenzylaminofluoran,

3-morpholino-5,6-benzofluoran,

3-ethyl-6-diethylaminofluoran,

2-anilino-6-diethylaminofluoran,

3-(N-methyl-N-cyclohexylamino)-6-methyl-7-anilino-fluoran, and

3-(N-p-tolyl-N-ethylamino)-6-methyl-7-(N-phenylamino)fluoran,

(c) phenothiazine dyes such as

benzoyl Leucomethylene Blue,

2,2-dimethyl Leucomethylene Blue,

p-anisoyl Leucomethylene Blue, and

N-pivalyl Leucomethylene Blue,

(d) Rhodamine lactam dyes such as

N-phenyl Rhodamine β lactam, and

acid Rhodamine β sulton, and

(e) spiropyran dyes such as

benzo- β -naphthospiropyran, and

1,3,3-trimethyl-6'-chloro-8'-methoxy-indolinobenzospiropyran. In addition to the above, it is utilizable 2-[3,6-bis(diethylamino)-9-(o-chloroanilino) xanthy] and benzoic lactam.

The color developer suitable for the thermal chromogenic layer 3 is preferably selected from phenolic compounds which liquefy or gasify at temperatures higher than room temperature so as to react with the above-described leuco-dye and thereby develop a color from the dye. The phenolic compounds preferably used in the present invention are as follows:

4,4'-isopropylidenediphenol,

4,4'-isopropylidenebis(2-chlorophenol),
 4,4'-isopropylidenebis(2-methylphenol),
 4,4'-isopropylidenebis(2-tert-butylphenol),
 4,4'-sec-butylidenediphenol,
 5 4,4'-cyclohexylidenediphenol,
 4-tert-butylphenol,
 4-tert-octylphenol,
 4-tert-octylcatechol,
 4-phenylphenol (i.e., p-phenylphenol)
 10 4-hydroxy diphenoxide,
 2,2-bis(p-hydroxyphenyl)propane (i.e., bisphenol A),
 2,2-bis(p-hydroxyphenyl)buthane,
 2,2-bis(2,5-dibrom-4-hydroxyphenyl)propane,
 2,2'-dihydroxydiphenol,
 15 2,2'-methylenebis(4-chlorophenol),
 α -naphthol,
 β -naphthol,
 methyl-4-hydroxybenzoate,
 benzyl-4-hydroxybenzoate,
 20 ethyl-4-hydroxybenzoate,
 propyl-4-hydroxybenzoate,
 4-hydroxy-acetophenone,
 novolak phenolic resins,
 halogenated novolak phenolic resins,
 25 other phenilic resins,
 benzoic acid,
 salicylic acid,
 tartaric acid,
 gellic acid.

30 The reaction promoter suitable for for the thermal chromogenic layer 33 is preferably selected from stearic acid amide, methylenebis(stearic acid amide), oleic acid amide, palmitic acid amide, sperm-whale oleic acid amide, coconut fatty acid amide, etc.

The binder suitable for the thermal chromogenic layer 33 is preferably selected from water-soluble polymer such as polyvinyl alcohol, starch, denatured starch, derivatives of starch, methyl cellulose,
 35 hydroxyethyl cellulose, carboxymethyl cellulose, gum arabic, gelatin, casein, polyvinyl pyrrolidone, polyacrylamide, salt of polyacrylic acid, styrene/butadien copolymer, polyvinyl acetate, ester of polyacrylic acid, or water emulsion of polymer such as polystyrene, polyvinyl chloride/polyvinyl acetate copolymer, polybutyl methacrylate.

The composition used for forming the thermal chromogenic layer 33 may further contain a white
 40 pigment such as talc, clay, silica, titanium oxide, or ureaformaldehyde resin; and/or an auxiliary agent such as various waxes, metallic salt of higher fatty acid, higher fatty acid amide, dispersant, lubricant, or anti-foamer. Here, the thermal chromogenic layer 33 is preferably coated and formed on the support sheet 34 with a thickness in a range of 2 ~ 20 g/ m², especially 5 ~ 10 g/ m², after being fully dried.

The barrier layer 32 is provided over the thermal chromogenic layer 33 to protect the thermal
 45 chromogenic layer 33 so that the thermal chromogenic layer 33 is not invaded by the solvent included in the solution of silicone resin which is curable at ordinary (room) temperature (later mentioned). The barrier layer 32 is preferably formed of various water-soluble resins which have film-forming ability. Such water-soluble resin is preferably selected from polyvinyl alcohol, methyl cellulose, ethyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyacrylamide, starch, gelatin, polyvinyl pyrrolidone, or methoxy cellulose. And the barrier layer 32 is formed of mixture including such one or two water-soluble resins
 50 selected from the above.

For protecting the thermal chromogenic layer 33 against water or moisture, the barrier layer 32 further contains an anti-water agent such as formal in, glyoxal, chrome alum, melamine, melamine formalin, polyamide resin, or polyamide epichlorhydrin resin. Here, the barrier layer 32 is preferably coated and
 55 formed on the chromogenic layer 33 with a thickness in a range of 0.5 ~ 10 g/ m², especially 1 ~ 5 g/ m², after being fully dried. The barrier layer 32 is different from the colored transparent layer 2 in the printing tape T at a point that pigment or dye is not contained in the barrier layer 32.

The protection layer 31 formed on the barrier layer 32 is mainly formed of the silicone resin which is curable at ordinary temperature. Such silicone resin may be used with the other resin in mixed state, for instance, polyvinyl resin, polyurethane resin, polyamide resin, polycarbonate resin or other silicone resin, and on the other hand, the above silicone resin curable at ordinary temperature may be independently
 5 used. For instance, as the silicone resin curable at ordinary temperature, resin silicone or rubber silicone curable at room temperature can be used. Concretely, various silicone coating agents (for instance, SR2410, SR2411, SE5060, SE5070, SE1980 from Toray Dow Corning Silicone Co Ltd.) are available for the protection layer 31.

For the ultraviolet absorbing agent contained in the protection layer 31, it is preferably selected from
 10 derivatives of benzotriazole such as :

2-(5-methyl-2-hydroxyphenyl)benzotriazole,
 2-[2-hydroxy-3,5-bis(α , α '-dimethylbenzyl) phenyl]-2H-benzotriazole,
 2-(3,5-di-t-butyl-5-methyl-2-hydroxyphenyl)benzotriazole,
 2-(3,5-t-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole,
 15 2-(3,5-di-t-butyl-2-hydroxyphenyl)-5-chlorobenzotriazole, and
 2-(3,5-di-t-amyl-2-hydroxyphenyl)benzotriazole.

For the support sheet 34 of the printing tape U, it is preferably selected from plastic films such as polyethylene film, polyamide film, polyester film, polypropylene film, polyvinylchloride film or papers such as craft paper, Japanese paper.

20 The adhesive used for forming the adhesive layer 35 is preferably selected from solvent-type acrylic adhesives, rubber adhesives, water-soluble adhesives, hot-melt adhesives, and emulsion-type adhesives. The removable sheet 36 is preferably produced by coating with silicone or polyethylene, opposite surfaces of a glassine paper, craft paper or polyethylene terephthalate (PET).

25 [Production of Printing Tape T]

For producing printing tape U, first, a first disperse system is prepared in which a leuco-dye and a binder are dispersed, and a second disperse system is prepared in which a color developer and the same binder are dispersed. The first and second disperse systems are mixed with each other, and are agitated to
 30 provide a coating material for forming the thermal chromogenic layer 33. The coating material is applied, by using a coating device such as a bar, air knife, comma coater, reverse roll, or gravure roll, to one surface of the support sheet 34. Subsequently, the applied material is dried by being subjected to hot air, so that the chromogenic layer 33 is formed on the support sheet 34.

After the thermal chromogenic layer 33 is formed, a coating material for forming the barrier layer 32 is
 35 applied onto the chromogenic layer 33 by the same coating device and the material is dried by being subjected to hot air, thereby the barrier layer 32 is formed on the chromogenic layer 33. At that time, the barrier layer 32 acts for protecting the thermal chromogenic layer 33 against the solvent in the resin solution including the resin curable at ordinary temperature, if it is conceivable that the solvent included in the resin solution for forming the protection layer 31 affects the chromogenic layer 33. Thereafter, the resin solution
 40 of the resin curable at ordinary temperature, in which the ultraviolet absorbing agent dispersed or dissolved, for forming the protection layer 31 is applied onto the barrier layer 32. And after the resin solution is dried, the protection layer 31 is formed. Further, the removable sheet 36, on one surface of which the adhesive layer 35 is coated, is adhered onto the opposite surface of the support sheet 34 through the adhesive layer 35. Thereby, the printing tape U is produced.

45 Next, an example of the concrete manner for producing the printing tape U will be detailedly described hereinafter.

[Example]

50 (a) Support Sheet 34

As the support sheet 34, a polyester film (CRISPER from Toyobo Co Ltd.) with 38 μ m thickness is prepared.

55 (b) Preparation Of Material For Thermal Chromogenic Layer 33

For preparing the coating material for forming the thermal chromogenic layer 33, first, a liquid A and a liquid B are prepared which have the following composition, respectively.

Liquid A		(parts by weight)
5	1. Leuco-dye crystal violet lactone	15
	2. Binder 20 % aqueous solution of polyvinyl alcohol	50
	3. Water	435
Liquid B		
10	1. Color developer bisphenol A	60
	2. Reaction promoter stearic acid amide	10
	3. Binder 20 % aqueous solution of polyvinyl alcohol	100
	4. Calcium carbonate	30
	5. Water	300

After the liquids A and B are prepared, each of the two liquids is homogenized using a ball mill, separately from each other, for twenty four hours. Subsequently, the liquids A, B are mixed with each other and sufficiently agitated to provide the coating material for forming the thermal chromogenic layer 33.

(c) Application Of The Coating Material

The thus obtained coating material is applied using a gravure roll to one of opposite major surfaces of the support sheet 34, to a thickness of 5 g/ m² after being dried. The applied material is dried into the thermal chromogenic layer 33 on the support sheet 34.

(d) Production Of The Barrier Layer 2

As a pre-treatment for forming the protection layer 31 mainly composed of silicone resin on the thermal chromogenic layer 33, aqueous solution, which includes 20 % of polyvinyl alcohol (produced by Kuraray Co. Ltd., Japan), denatured NBR (nitril•butadiene rubber produced by Takeda Chemical Industries Co. Ltd.) and acryl emulsion with self-crosslinking ability (produced by Rohm Co. Ltd.), is prepared. Thereafter, the thus prepared solution is coated on the thermal chromogenic layer 33 through the gravure roll, to a thickness of 2 g/ m² after being dried, thereby the barrier layer 32 is formed on the chromogenic layer 33.

(e) Production Of The Protection Layer 31

First, to form the protection layer 31, urethane resin solution in which silicone resin is mixed is prepared according to the following composition.

[Urethane resin solution]		(parts by weight)
40	1. Polyurethane (UA-90 produced by Sanyo Chemical Industries Co. Ltd.)	100
	2. Polyurethane crosslinking agent (SCAT-24 produced by Sanyo Chemical Industries Co. Ltd.)	1
	3. Silicone resin curable at ordinary temperature (SR2411 produced by Toray Dow Corning Silicone Co. Ltd.)	30
	4. Ultraviolet absorbing agent (2-(5-methyl-2-hydroxyphenyl)benzotriazole)	3
	5. Toluene	100

The above compounds are mixed and agitated, thereby the urethane resin solution is prepared. Thereafter, the urethane resin solution is coated through the gravure roll on the barrier layer 32, to a thickness of 2 g/ m² after being dried. Thereby, the protection layer 31 is formed on the barrier layer 32 by drying.

(f) Preparation Of The Removable Sheet 36

First, an adhesive is prepared which has the following composition:

5	[Adhesive]	(parts by weight)
	1. Oil and fat (Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	100
	2. Isocyanate-type hardener (B-45 from Ipposha Oil Industries Co. Ltd., Japan)	2
10	3. Ethyl acetate	30

The above compounds are mixed and agitated to provide an adhesive, which is then applied using a comma coater to one of opposite major surfaces of the removable sheet 36 formed of a 60 μm thick paper whose surfaces have been coated with silicone. Thus, the adhesive layer 35 is formed on the removable sheet 36, to a thickness of 20 g/ m^2 after sufficiently being dried.

(g) Production Of Printing Tape U

The thus prepared removable sheet 36 is adhered on the surface of the support sheet 34, opposite to the surface where the thermal chromogenic layer 33, the barrier layer 32 and the protection layer 31 are formed. Thereby, the printing tape U is produced.

[Production Of Printed Sample]

Hereinafter, by reference to Figs. 3 and 5, there will be described the manner of production of printed tape by using the printing tape U. Here, Fig. 5 is a plan view of a lower half housing of a tape cartridge, with an upper half of housing (not shown) being removed. And the tape cartridge is utilized in the tape printer 20 shown in Fig. 3.

First, the printing tape U as described above is cut into 12 mm width web before the printing tape U is arranged in the cartridge C. Subsequently, the thus obtained printing tape U is wound around a tape spool 10 having a 12 mm outer diameter and a 12 mm height, such that the removable sheet 36 is located outside. The tape spool 10 is accommodated in the lower housing 11, as shown in Fig. 5, such that the tape spool 10 is rotatably supported by the lower housing and the upper housing (not shown).

In the lower housing 11, the printing tape U is fed from the tape spool 10 to a printing section 13 via a tape guide member 12. The feeding of the printing tape U is effected by a tape feed roller 14 which is driven, when the cartridge C is set in the printer 20, by a tape feed shaft 21 of the printer 20. With the cartridge C being set in the printer 20, the thermal head 15 of the printer 20 is positioned in the printing section 13. The thermal head 15 is fixedly disposed in a cartridge receiving area 22 of the printer 20, and has a plurality of heat generating elements vertically arranged in an array. In addition, the printer 20 has a roller support member 16 which is disposed opposite to the thermal head 15 such that the roller support member 16 is pivotable about an axis member 19 fixed to the printer 20.

A platen roller 17 and a presser roller 18 are rotatably supported by the roller support member 16. When the thermal head 15 records characters and/or other images on the printing tape U, the roller support member 16 is rotated counterclockwise about the axis member 19. Thus, the platen roller 17 is pressed against the thermal head 15, so that the thermal head 15 can record with stability images in the thermal chromogenic layer 33 of the printing tape U. Concurrently, the presser roller 18 is pressed against the tape feed roller 14 of the cartridge C, so that the two rollers 18, 14 cooperate with each other to feed the thus printed length of the printing tape U out of the cartridge C.

The tape cartridge C is inserted in the tape receiving area 22 provided in a rear section (in the right-hand portion as seen in Fig. 3) of the printer 20. Electric current is selectively applied to the individual heat generating elements of the thermal head 15, so that the thermal head 15 heats selected areas of the thermal chromogenic layer 33 of the printing tape U. The chromogenic material reacts with the color developer and thereby develops color, in the heated areas of the chromogenic layer 33. Thus, the desired images such as characters are imprinted in the chromogenic layer 33 of the printing tape U.

Thereafter, the printing tape U on which the images are imprinted is fed out of the tape cartridge C through cooperation of the tape feed roller 14 and the presser roller 18. And the fed out printing tape U is cut out by a cutter, and thus cut out printing tape U becomes the printed sample (tape).

The printed tape, which is produced by imprinting the images in the chromogenic layer 33 of the printing tape U through the tape printer 20, can be adhered on an object through adherent force of the

adhesive layer 35 after the removable sheet 36 is peeled.

[Production Of Comparative Printed Sample]

For carrying out various comparative tests on the printed sample (the invention sample) produced above, a comparative sample is produced. Here, the comparative sample is produced by using a comparative printing tape which is basically the same as the printing tape U used for producing the invention sample, but is different from the printing tape U in that the protection layer 31 formed on the comparative printing tape does not contain ultraviolet absorbing agent (2-(5-methyl-2-hydroxyphenyl) benzotriazole) and 5% of calcium oxide in solid fraction is contained in the barrier layer 32 of the comparative printing tape. The comparative sample is produced like the invention sample, by (a) incorporating the comparative printing tape into the tape cartridge C; (b) inserting the cartridge C in the tape printer 20 shown in Fig. 3; (c) and operating the thermal head 15 to effect desired printing on the comparative printing tape.

[Comparison Between Invention Sample And Comparative Sample]

In order to examine effect of the ultraviolet absorbing agent contained in the protection layer 31 of the invention sample, optical density of the printed portion (where the images are formed) and the non-printed portion (the portion except for the printed portion) in each of both the invention printed sample and the comparative sample is measured and compared, respectively. The measured results of the optical density are shown in Fig. 6.

In Fig. 6, the results are shown as graphs in which the abscissa represents the ultraviolet (UV) exposure time in which each sample is exposed to UV rays and the ordinate represents the measured optical densities. Here, the measurement of the optical density is carried out by exposing each sample to 300 nm to 400 nm wavelength UV rays having an irradiance of 50 W/ m² for 72 hours by a xenon lamp, and measuring the optical densities of the printed and non-printed portions of each sample at every 24 hours. More specifically, colorimeter (CM-2002 from Minolta Camera Co. Ltd., Japan) is used to measure a reflectance of the test portion at every 5 nm wavelength within the range of visible rays (i.e., from 400 nm to 700 nm wavelengths), and an optical density is determined by averaging the logarithms of the inverses of the measured reflectance values. In the graph of Fig. 6, symbol " triangle " (Δ) indicates the optical densities of the printed portion of the invention sample; symbol " plus " (+) indicates the optical densities of the non-printed portion of the invention sample; symbol " diamond " ($\diamond$) indicates the optical densities of the printed portion of the comparative sample; and symbol " square " ($\square$) indicates the optical densities of the non-printed portion of the comparative sample.

In Fig. 6, comparing the optical densities of the printed portions in both the invention sample and the comparative sample, the graph of Fig. 6 shows that the optical densities of the printed portion of the invention sample are changed from 1.53 to 1.31 during the 72 hours UV exposure and therefore the density change is only 0.22 whereas the optical densities of the printed portion of the comparative sample are change from 1.53 to 1.16 under the same conditions and the density change is 0.37 much greater than 0.22. It is speculated that since the protection layer formed on the comparative sample does not contain the ultraviolet absorbing agent, the color images on the chromogenic layer 3 have discolored due to the exposure to the UV rays. Although discoloration occurs to some degree regarding the images recorded on the invention sample, such degree is much lower than that of the comparative sample because the protection layer 31 of the invention sample contains the ultraviolet absorbing agent.

Next, comparing the optical densities of the non-printed portions in both the invention sample and the comparative sample, the graph of Fig. 6 shows that the optical densities of the non-printed portion of the invention sample are changed from 0.08 to 0.18 during the 72 hours UV exposure and thus the density change is only 0.1 whereas the optical densities of the non-printed portion of the comparative sample are changed from 0.08 to 0.30 under the same conditions and the density change is 0.22 much greater than 0.1. It is estimated that since the protection layer of the comparative sample does not contain ultraviolet the absorbing agent, the protection layer of the comparative sample has changed in yellow due to the exposure to the ultraviolet rays. Although yellowing occurs to some degree regarding the non-printed portion of the invention sample, such degree is much lower than that of the comparative sample because the protection layer 31 of the invention sample contains the ultraviolet absorbing agent.

Thus, the ultraviolet absorbing agent contained in the protection layer 31 of the invention sample effectively protects, against ultraviolet rays, not only the printed (colored) portion but also the non-printed portion of the chromogenic layer 33 of the invention sample.

[Printing Test]

In order to compare the abrasion amount of the thermal head 15 when printing is done by using the printing tape U with the abrasion amount of the thermal head 15 when printing is done by using the comparative printing tape, printing test is conducted as follows.

Here, in the printing test, a tape printer having a thermal head 15 (TR66 from King Jim Co. Ltd., Japan) is utilized and the abrasion amount of the thermal head 15 is measured by a micrometer after each of the printing tape U and the comparative printing tape is relatively run by 1.5 km while contacting with the thermal head 15. In measurement of the abrasion amount, the height H of the thermal head 15 (see Fig. 7) is measured in both cases of before printing and after printing and the abrasion amount is defined by change amount of the height H obtained through measurement.

Results of the printing test are shown in Fig. 8. Fig. 8 is a table showing the change of the abrasion amount in the thermal head 15 through the above printing test. Clearly understood from the table of Fig. 8, the height H of the thermal head 15 is changed from 2.570 mm before printing to 2.561 mm after printing when using the comparative printing tape. Thus, it is understood that the height H of the thermal head 15 is abraded by 0.009 mm during the printing test in which the thermal head 15 is relatively moved while contacting with the comparative printing tape. It is estimated that, since the fine particles of calcium oxide are contained in the barrier layer 2 of the comparative printing tape as mentioned above, such abrasion change occurs due to that the thermal head 15 is abraded by the fine particles of calcium oxide while printing test.

On the contrary, when the printing tape U is used, the height H of the thermal head 15 before printing is 2.621 mm and the height H thereof after printing is 2.620 mm. Therefore, the thermal head 15 is abraded only by 0.001 mm in use of the printing tape U while printing test. It is estimated in case of the printing tape U that, since the thermal head 15 is smoothly and relatively moved on the protection layer 31 composed of the silicone resin curable at ordinary temperature while printing, the thermal head 15 is not abraded based on the characteristic of the protection layer 31. Therefore, life of the thermal head 15 can be remarkably lengthened if the printing tape U is utilized.

As detailedly mentioned, according to the printing tape U of the second embodiment, the barrier layer 32 is formed on the chromogenic layer 33 on one surface of the support sheet 34 and the protection layer 31, in which the ultraviolet absorbing agent is contained, is formed on the barrier layer 32. Therefore, not only both the printed portion and the non-printed portion in the printing tape U can be effectively protected against UV rays, but also it can prevent the non-printed portion from being changed in yellow. Thus, the printing tape U which is stably utilizable for long time without inferiority of the images can be obtained.

Further, the protection layer 31 is mainly formed of the silicone resin curable at ordinary temperature and the thermal head 15 of the printer 20 is relatively moved while contacting with the protection layer 31 when printing of the images is conducted. At that time, the thermal head 15 and the printing tape U are relatively and smoothly moved with each other through the protection layer 31 formed of the silicone resin. In addition, life of the thermal head 15 can be lengthened without abrasion thereof.

And in the printing tape U, the barrier layer 32 is formed between the thermal chromogenic layer 33 and the protection layer 31, therefore it can prevent the solvent included in the urethane resin solution for forming the protection layer 31 from affecting or invading the thermal chromogenic layer 33, when coating the urethane resin solution on the thermal chromogenic layer 33 to form the protection layer 31.

And further, the adhesive layer 35 is exposed on the surface of the support sheet 34 opposite to the surface where the thermal chromogenic layer 33 is formed by peeling the removable sheet 36 from the printed tape, therefore the printed tape can be adhered on a surface of a desired object through adherent force of the adhesive layer 35.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details can be made therein without departing from the spirit and scope of the invention.

Claims

1. A printing tape having a support sheet (4), a heat-sensitive layer (3) formed on one surface of the support sheet (4) and a transparent protection layer formed on the heat-sensitive layer, the printing tape being used for a tape-recording printer including a thermal head which thermally records images on the printing tape, the printing tape comprising:
a colored transparent layer (2) which includes colorant, the colored transparent layer (2) being formed between the heat-sensitive layer (3) and the protection layer (1).

2. The printing tape according to claim 1, wherein the protection layer (1) is mainly formed of resin curable at ordinary temperature.
3. The printing tape according to claim 2, wherein the resin in the protection layer (1) is composed of
5 silicone resin or urethane resin which is curable at ordinary temperature.
4. The printing tape according to one of claims 1 to 3, wherein the colorant is composed of pigment dispersed or of dye dissolved in the colored transparent layer (2).
- 10 5. The printing tape according to claim 4, wherein the pigment is organic pigment or inorganic pigment.
6. The printing tape according to claim 4, wherein the dye is selected from the group consisting of xanthene dye, coumalin dye, merocyanine dye, thiazine dye, azine dye, methine dye, oxazine dye, phenylmethane dye, cyanin dye, azo dye, anthraquinone dye, pyrazoline dye, stilbene dye and
15 quinoline dye.
7. The printing tape according to one of claims 1 to 6, wherein the protection layer (1) is formed on the colored transparent layer (2) by coating solution in which the resin curable at ordinary temperature and solvent are mixed with each other, and wherein the colored transparent layer (2) protects the heat-
20 sensitive layer (3) from the solvent in the solution.
8. The printing tape according to one of claims 1 to 7, wherein the colored transparent layer is formed of one or more water-soluble resins which have film-forming ability, the water-soluble resin being preferably selected from the group consisting of polyvinyl alcohol, methyl cellulose, ethyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyacrylamide, starch, gelatin, polyvinyl pyrrolidone and methoxy cellulose.
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9. The printing tape according to one of claims 1 to 6, wherein the protection layer is formed on the colored transparent layer by coating solution in which the resin curable at ordinary temperature and water are mixed with each other, and wherein the colored transparent layer protects the heat-sensitive layer from the water in the solution, and wherein the colored transparent layer preferably includes anti-
30 water agent, the anti-water agent being preferably selected from the group consisting of formalin, glyoxal, chrome alum, melamine, melamine formalin, polyamide resin and polyamide epichlorhydrin resin.
35
10. The printing tape according to one of claims 1 to 9, further comprising an adhesive layer (5) formed on the other surface of the support sheet (4) opposite to the one surface where the heat-sensitive layer is formed and a removable sheet (6) adhered on the adhesive layer (5).
- 40 11. The printing tape according to claim 10, wherein the printing tape is used so as to adhere on an object through the adhesive layer by removing the removable sheet therefrom after the images are thermally recorded by the thermal head in the tape-recording printer.
12. The printing tape according to one of claims 1 to 11, wherein the protection layer includes ultraviolet
45 absorbing agent.
13. A printing tape (U) having a support sheet (34), a heat-sensitive layer (33) formed on one surface of the support sheet (34) and a protection layer (31) formed on the heat-sensitive layer (33), the printing tape being used for a tape-recording printer including a thermal head which thermally records images on the
50 printing tape through the heat-sensitive layer,
wherein the protection layer (31) is mainly formed of silicone resin curable at ordinary temperature and includes ultraviolet absorbing agent.
14. The printing tape according to claim 13, further comprising a barrier layer (32) formed between the
55 heat-sensitive layer and the protection layer.
15. The printing tape according to claim 13 or 14, wherein the protection layer (31) is formed on the barrier layer (32) by coating solution in which the silicone resin curable at ordinary temperature and solvent are

mixed with each other, and wherein the barrier layer protects the heat-sensitive layer from the solvent in the solution.

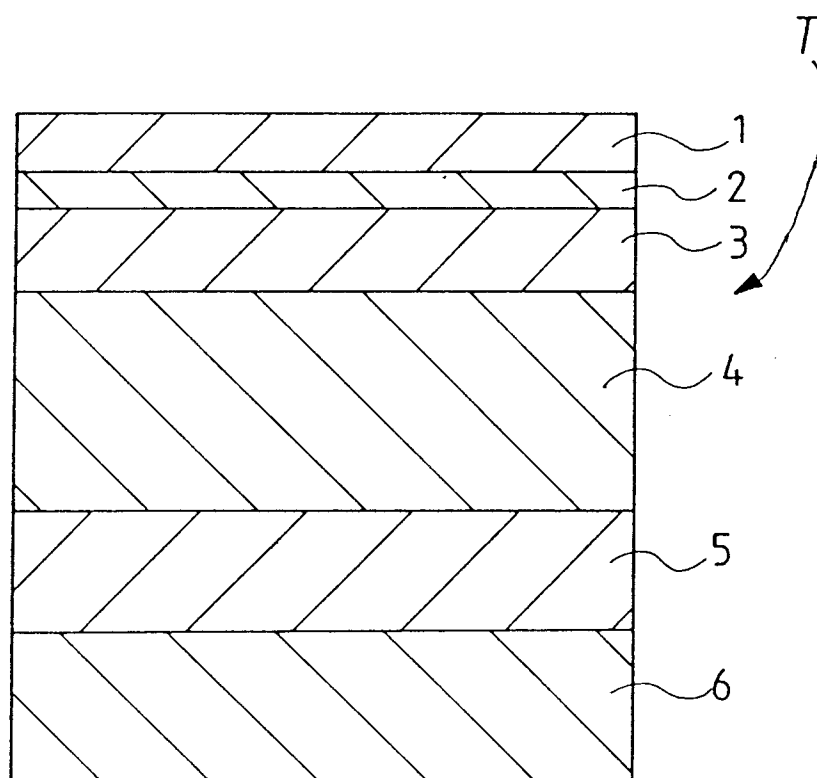
- 5 16. The printing tape according to one of claims 13 to 15, wherein the barrier layer (32) is formed of one or more water-soluble resins which have film-forming ability, the water soluble resin being preferably selected from the group consisting of polyvinyl alcohol, methyl cellulose, ethyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyacrylamide, starch, gelatin, polyvinyl pyrrolidone and methoxy cellulose.
- 10 17. The printing tape according to one of claims 13 to 16, wherein the protection layer (31) is formed on the barrier layer by coating solution in which the silicone resin curable at ordinary temperature and water are mixed with each other, and wherein the barrier layer protects the heat-sensitive layer from the water in the solution and wherein the barrier layer preferably includes anti-water agent, the anti-water agent being preferably selected from the group consisting of formalin, glyoxal, chrome alum, melamine, 15 melamine formalin, polyamide resin and polyamide epichlorhydrin resin.
18. The printing tape according to one of claims 13 to 17, further comprising an adhesive layer formed on the other surface of the support sheet opposite to the one surface where the heat-sensitive layer is formed and a removable sheet adhered on the adhesive layer.
- 20 19. The printing tape according to one of claims 1 to 18, wherein the printing tape is used so as to adhere on an object through the adhesive layer by removing the removable sheet therefrom after the images are thermally recorded by the thermal head in the tape-recording printer.
- 25 20. The printing tape according to one of claims 12 to 19, wherein the ultraviolet absorbing agent is composed of benzotriazole derivative.
21. The printing tape according to claim 20, wherein the benzotriazole derivative is selected from the group consisting of 2-(5-methyl-2-hydroxyphenyl)benzotriazole, 30 2-[2-hydroxy-3,5-bis(α , α' -dimethylbenzyl) phenyl]2H-benzotriazole, 2-(3,5-di-t-butyl-5-methyl-2-hydroxyphenyl)benzotriazole, 2-(3,5-t-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole, 2-(3,5-di-t-butyl-2-hydroxyphenyl)-5-chlorobenzotriazole, and 2-(3,5-di-t-amyl-2-hydroxyphenyl)benzotriazole.
- 35 22. A printing-tape cartridge accommodating a printing tape according to one of claims 1 to 21, for use with a tape-recording printer including a thermal head which thermally records images on the printing tape, the printing-tape cartridge comprising:
 - a housing;
 - 40 a tape spool disposed inside the housing so that the tape spool is rotatable, the printing tape being wound around the tape spool.

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FIG. 1



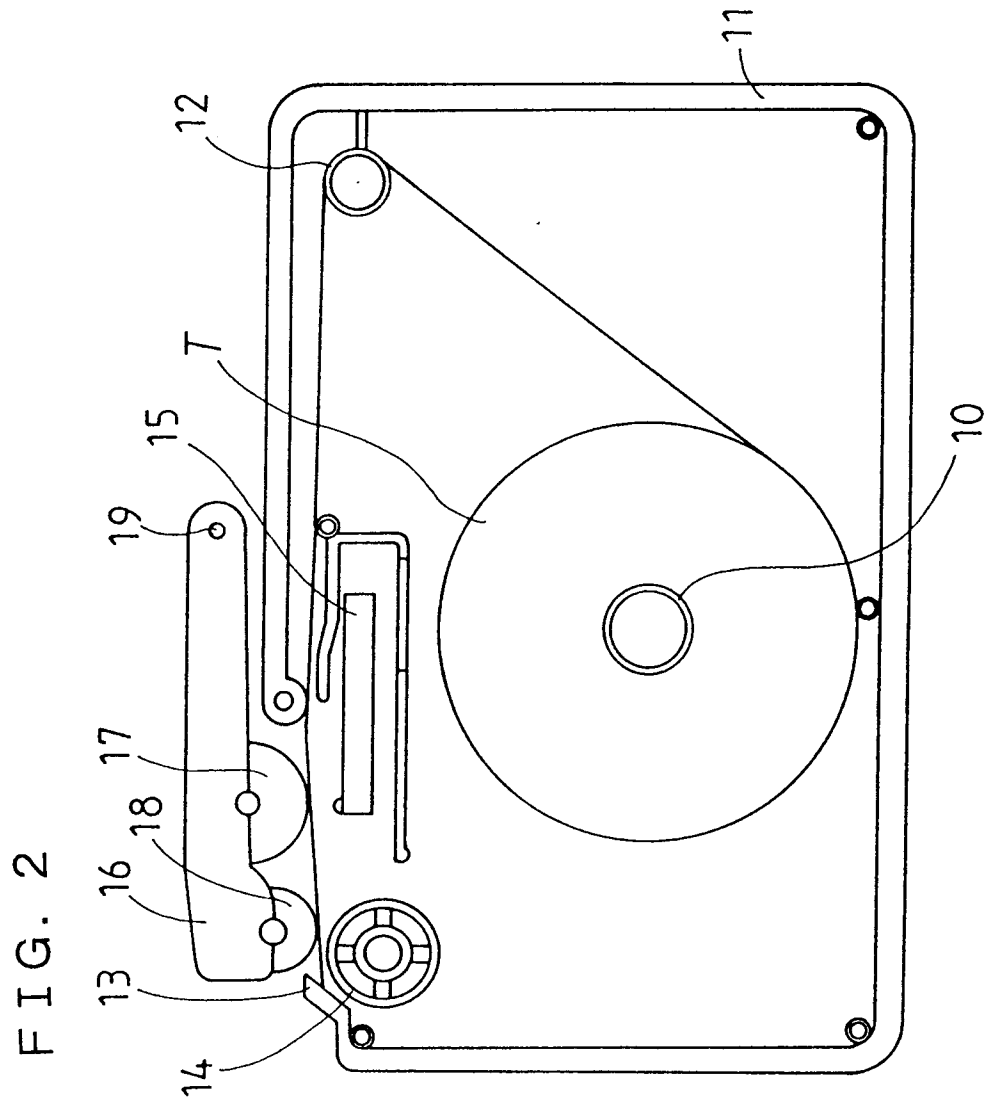


FIG. 3

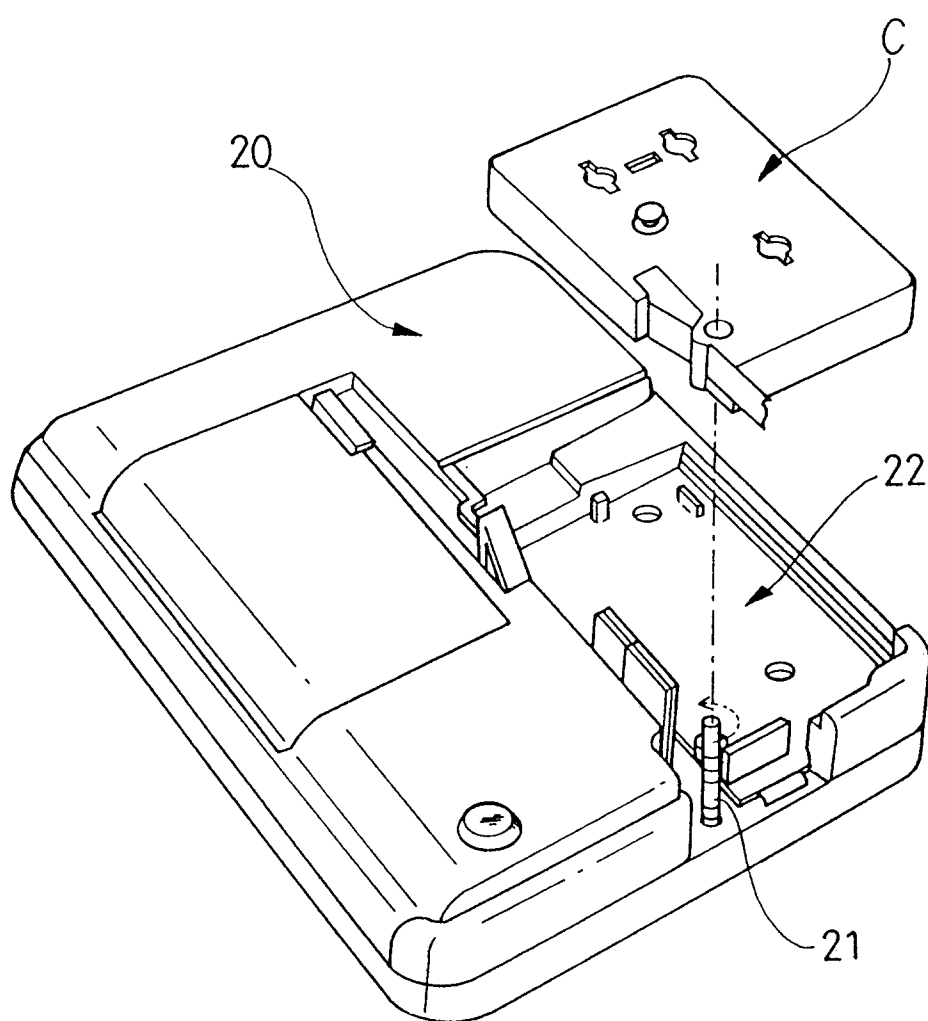
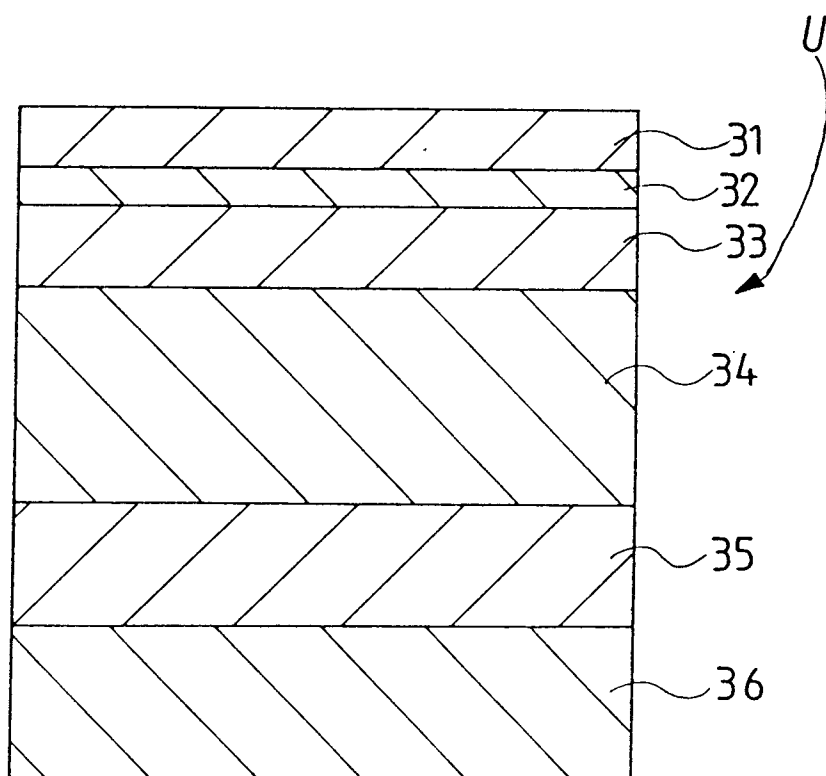


FIG. 4



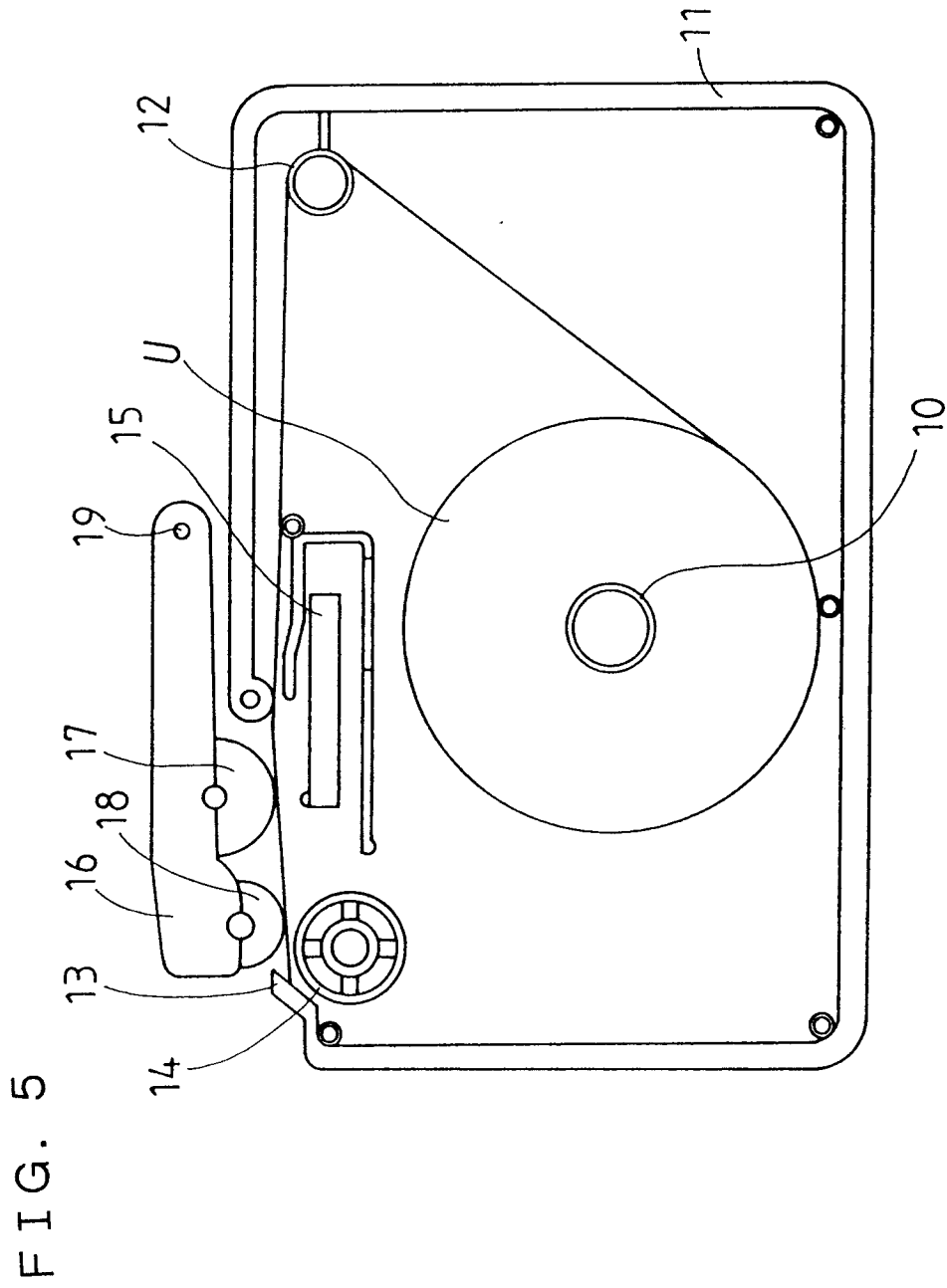


FIG. 6

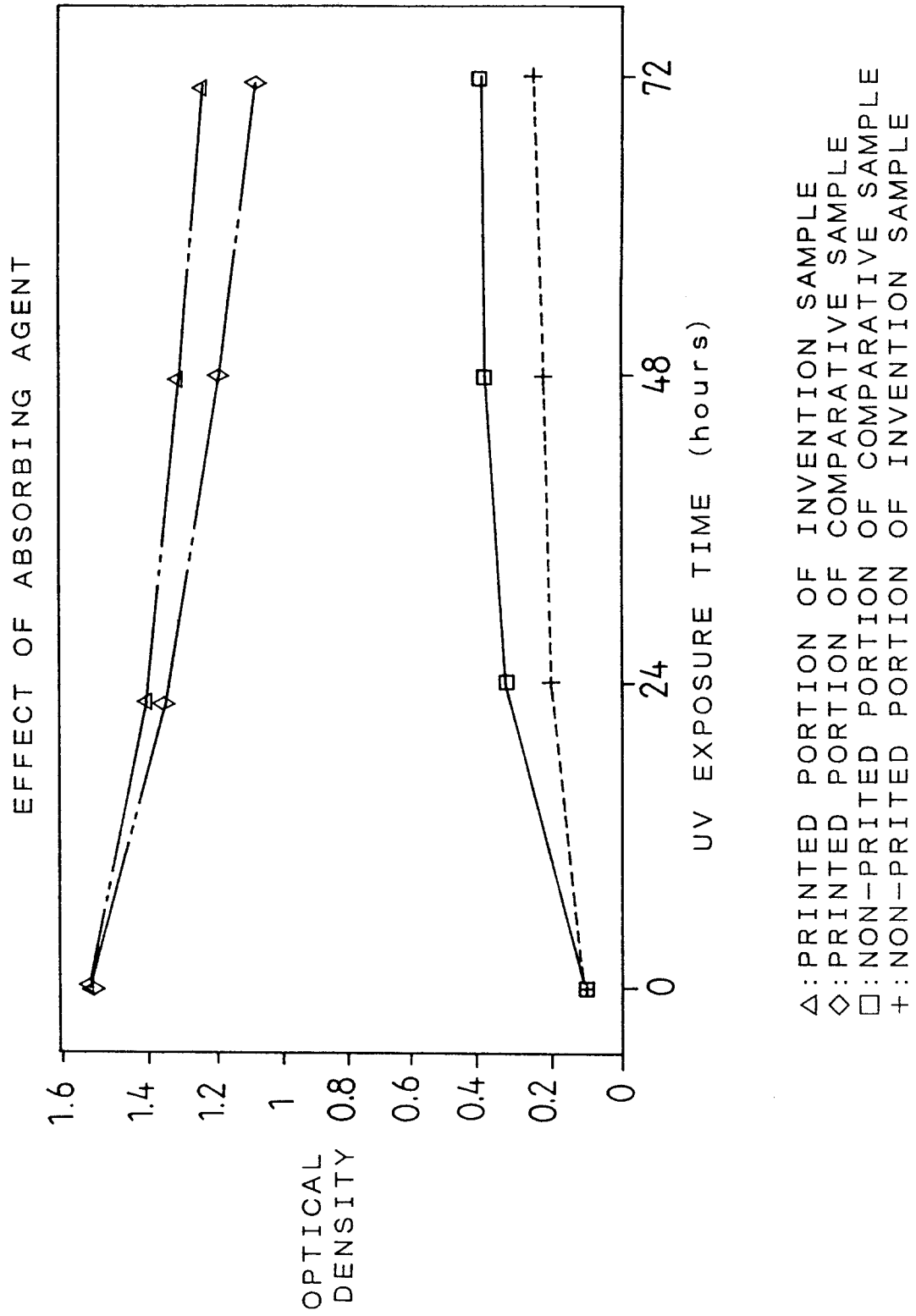


FIG. 7

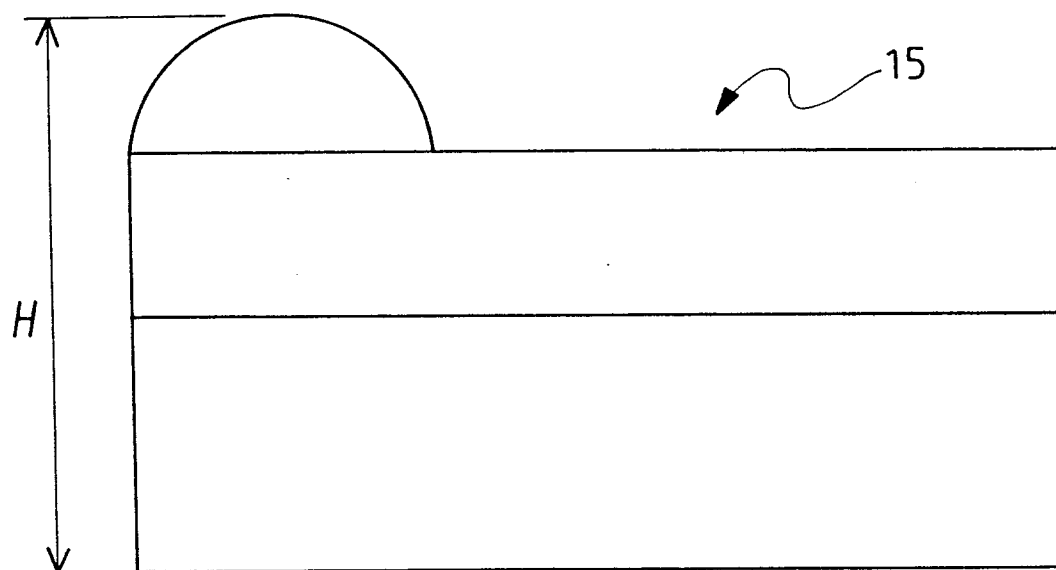


FIG. 8

Printing tape	before printing	after printing	abrasion change
Comparative printing tape	2.570 (mm)	2.561 (mm)	0.009 (mm)
Printing tape U	2.621 (mm)	2.620 (mm)	0.001 (mm)