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(71) Applicant : **BROTHER KOGYO KABUSHIKI KAISHA**
No. 15-1, Naeshiro-cho, Mizuho-ku
Nagoya-shi, Aichi-ken 467 (JP)

(72) Inventor : **Norimatsu, Takahiro, c/o Brother Kogyo K. K.**
15-1 Naeshiro-cho, Mizuho-ku
Nagoya-shi, Aichi-ken (JP)
Inventor : **Takatugi, Masaki, c/o Brother Kogyo K. K.**
15-1 Naeshiro-cho, Mizuho-ku
Nagoya-shi, Aichi-ken (JP)

(74) Representative : **Price, Nigel John King**
J.A. KEMP & CO. 14 South Square Gray's Inn
London WC1R 5LX (GB)

(54) Printing tape and printing-tape cartridge.

(57) A printing tape (A, B, E, F, G, H) for use with a tape-recording printer (20, 120) having a thermal head (15, 115) which thermally records images on the printing tape, including a heat-sensitive layer (2, 102, 203, 303, 402) containing a heat-sensitive chromogenic material, the heat-sensitive layer producing the images when being heated by the thermal head ; and an ultraviolet absorbing layer (1, 101, 201, 302, 401) containing an ultraviolet absorbing agent, the ultraviolet absorbing layer being provided over one of opposite major surfaces of the heat-sensitive layer on a side of incidence of ultraviolet rays to the printing tape in use. A printing tape (J) for use with a tape-recording printer (120), including a heat-sensitive layer (502) containing a heat-sensitive chromogenic material, the heat-sensitive layer producing images when being heated by a thermal head of a printer, the heat-sensitive layer containing an ultraviolet absorbing agent in addition to the heat-sensitive chromogenic material. A printing-tape cartridge (C, X, Y, Z, Q, S) accommodating a printing tape (A, B, E, F, G, H, J), for use with a tape-recording printer (20, 120), the cartridge including a housing (11, 111, 211, 311, 411, 511) ; a tape spool (10, 23, 110, 210, 310, 410, 510) disposed inside the housing such that the tape spool is rotatable ; and the printing tape being wound around the tape spool.

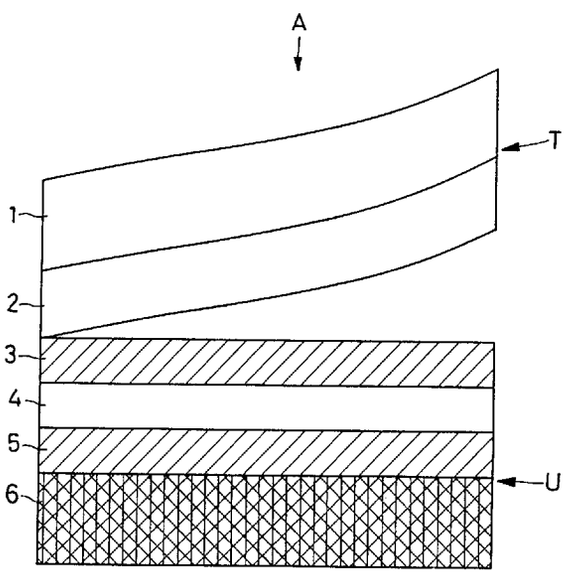

FIG.1

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The present invention relates to a printing tape, and a printing-tape cassette or cartridge accommodating a printing tape therein, which are used with a tape-recording printer having a thermal head.

There have been proposed various tape-recording printers having a thermal head which records images such as characters on a printing tape. In general, a printing-tape cartridge accommodating a web-like printing tape therein is inserted in a tape-recording printer, so that a thermal head of the printer records, via a printer ribbon, images on a length of the tape as the tape is fed out of the cartridge. The thus printed length of the tape is cut off the remainder of the tape, and is used for being adhered to, e.g., the back face of a video cassette.

The above tape-recording printers are generally grouped, on a printing-manner basis, into the "non-laminating" type printers and the "laminating" type printers.

A "non-laminating" type printer is disclosed in European Patent Application published under Publication No. 0272232 A2. The disclosed printer has a thermal head which thermally records, via a printer ribbon, images on a non-adhesive surface of a printing tape which has on the opposite side an adhesive surface over which a removable sheet has been provided. No protection is applied to the printed surface of the tape.

Meanwhile, a "laminating" type printer is disclosed in Japanese Utility Model Application published under Publication No. 1(1989)-104359. The disclosed printer has a thermal head which thermally records, via a printer ribbon, laterally reversed or mirror images on one of opposite major surfaces of a printing tape (i.e., first tape) formed of a transparent or translucent film. The printed surface of the tape is protected with a double coated adhesive tape (i.e., second tape) over one of opposite surfaces of which a removable sheet has been provided.

Images recorded by the "non-laminating" type printer on a printing tape easily come off the tape, since no protection is applied to the printed surface of the tape. Thus, the images on the tape suffer from low abrasion resistance. On the other hand, since the image-bearing surface of a printing tape produced by the "laminating" type printer is protected with a double coated adhesive tape having a removable sheet, the images on the tape enjoy high abrasion resistance.

In either type of the above tape-recording printers, a printer ribbon is used for thermally recording images on a printing tape.

However, regarding printing tapes used with the above-mentioned conventional printers, generally, no attention has been used to deterioration and/or discoloration of the tapes due to ultraviolet rays to which the tapes in use are exposed. Thus, the conventional printers have suffered from the problem that the printing tapes produced thereby deteriorate and/or discolor (or become yellowish) in a long time of use due to the ultraviolet rays which are mainly contained in the daylight incident to the tapes adhered in use on objects. In the case where the printers perform printing using a ribbon on a printing tape, the ink used in the ribbon cannot easily deteriorate and/or discolor due to ultraviolet rays because the ink is essentially constituted by carbon and wax. However, the printing tape itself easily deteriorates and/or discolors due to the ultraviolet rays. In the event that the printers are used at light places full of daylight, the printing tapes used with the printers will discolor or become yellowish even in a short time.

In addition, since the inks provided on the ribbons used with the conventional tape-recording printers contain waxes which melt at low temperatures, quality of printing may adversely be affected by ambient temperatures. For example, when printing using a ribbon is performed at high temperatures, unclear or undefined images may be produced because of the ink melted on the ribbon. Consequently, printing of characters and/or other images cannot be performed with high stability on a printing tape, and thus quality of printing is lowered.

Furthermore, a printing tape and a printer ribbon used with the conventional printers are accommodated in a single tape cartridge such that the tape and ribbon are wound around different spools, respectively. The printers includes feed means for feeding the tape and the ribbon independently of each other, and control means for controlling the feed means so that the feeding of the tape is harmonized with the feeding of the ribbon. However, this is very difficult.

As described above, a printing tape and a printer ribbon are wound on respective spools, and a certain number of parts are needed for smoothly feeding each of the tape and the ribbon. Thus, tape cartridges used with the conventional printers need a large number of parts to be disposed therein. Thus, it is very difficult to reduce the overall size of the tape cartridges or reduce the production cost of the same.

It is an object of the present invention to provide a printing tape which enables clear images such as characters to be recorded thereon and which is free from the conventionally encountered problem that the tape itself and/or the images recorded thereon deteriorate and/or discolor due to adverse influences of ultraviolet rays.

It is another object of the present invention to provide a printing-tape cartridge which accommodates such a printing tape as indicated above and thus does not need a printer ribbon or parts for feeding the ribbon, and therefore which enjoys simplified control for feeding the tape, reduced overall size thereof, reduced number of parts disposed therein, and lowered production cost thereof.

According to a first aspect of the present invention, there is provided a printing tape for use with a tape-recording printer including a thermal head which thermally records images such as characters on the printing tape, comprising: a heat-sensitive layer containing a heat-sensitive chromogenic material, the heat-sensitive layer producing the images when being heated by the thermal head; and an ultraviolet absorbing layer containing an ultraviolet absorbing agent, the ultraviolet absorbing layer being provided over one of opposite major surfaces of the heat-sensitive layer on a side of incidence of ultraviolet rays to the printing tape in use.

For example, the printing tape constructed as described above is wound on a tape spool which is rotatably accommodated in a printing-tape cartridge. As the printing tape is fed out of the cartridge, the thermal head of the tape-recording printer thermally records characters and/or other images on a length of the printing tape. More specifically, selected areas of the heat-sensitive chromogenic layer of the tape produce color by being heated by individual heat-generating elements of the thermal head, so that the colored selected areas provide the desired images. Since the ultraviolet absorbing layer effectively absorbs the ultraviolet rays incident to the printing tape, not only the images recorded on the tape but also the non-printed portion or background in the tape where no image is recorded, are well protected against deterioration and/or discoloration due to the ultraviolet rays, even if the tape is exposed to the ultraviolet rays for a long period of use.

In a preferred embodiment according to the first aspect of the present invention, the printing tape further comprises: a support layer; an adhesive layer provided over one of opposite major surfaces of the support layer; and a removable sheet provided over the adhesive layer, the heat-sensitive layer being provided over the support layer such that the other major surface of the heat-sensitive layer is opposite to the other major surface of the support layer, the removable sheet being removed when the printing tape is used, so that the printing tape is adhered to an object via the adhesive layer and so that the ultraviolet rays are incident to the ultraviolet absorbing layer located over the one major surface of the heat-sensitive layer in the printing tape adhered in use to the object.

Since the heat-sensitive layer is protected by the ultraviolet absorbing layer and the support layer which are provided on both sides of the heat-sensitive layer, the images recorded in the heat-sensitive layer are well prevented from coming off the printing tape adhered in use on an object. Thus, the images recorded in the tape enjoy high abrasion resistance. In this case, the ultraviolet absorbing layer may be formed as a top or overcoat layer of the printing tape.

In another embodiment according to the first aspect of the present invention, the printing tape further comprises a barrier layer interposed between the one major surface of the heat-sensitive layer and the ultraviolet absorbing layer.

In the above embodiment, the barrier layer prevents the heat-sensitive layer from adversely being influenced by the ultraviolet absorbing layer.

In another embodiment according to the first aspect of the present invention, the printing tape further comprises an overcoat layer provided over the ultraviolet absorbing layer provided over the one major surface of the heat-sensitive layer.

In the above embodiment, the overcoat layer protects the heat-sensitive layer, therefore the images recorded in the heat-sensitive layer enjoy enhanced abrasion resistance, i.e., are effectively prevented from coming off the printing tape.

In yet another embodiment according to the first aspect of the present invention, the heat-sensitive layer contains a photostabilizing agent in addition to the heat-sensitive chromogenic material.

In the above embodiment, the photostabilizing agent contained in the heat-sensitive layer effectively prevents the heat-sensitive layer from aging, discoloration, and/or yellowing due to the ultraviolet rays incident to the printing tape.

In a further embodiment according to the first aspect of the present invention, the printing tape further comprises: a support layer; a first adhesive layer provided over one of opposite major surfaces of the support layer; a second adhesive layer provided over the other major surface of the support layer; and a removable sheet provided over the first adhesive layer, the heat-sensitive layer over which the ultraviolet absorbing layer is provided being adhered via the second adhesive layer to the support layer such that the other major surface of the heat-sensitive layer is opposite to the other major surface of the support layer, the removable sheet being removed when the printing tape is used, so that the printing tape is adhered to an object via the first adhesive layer and so that the ultraviolet rays are incident to the ultraviolet absorbing layer located over the one major surface of the heat-sensitive layer in the printing tape adhered in use to the object.

In the above embodiment, after images are thermally recorded in the heat-sensitive chromogenic layer provided over the ultraviolet absorbing layer, those two layers are adhered to the support layer via the second adhesive layer. Thus, a printing tape is produced in which images have been recorded. The ultraviolet absorbing layer may contain a photostabilizing agent in addition to the ultraviolet absorbing agent. The printing tape may further comprise an overcoat layer provided over the other major surface of the heat-sensitive layer. In this

case, the heat-sensitive layer is heated via the overcoat layer by the thermal head.

According to a second aspect of the present invention, there is provided a printing tape for use with a tape-recording printer including a thermal head which thermally records images such as characters on the printing tape, comprising: a heat-sensitive layer containing a heat-sensitive chromogenic material, the heat-sensitive layer producing the images when being heated by the thermal head, the heat-sensitive layer containing an ultraviolet absorbing agent in addition to the heat-sensitive chromogenic material.

Since the ultraviolet absorbing agent effectively absorbs the ultraviolet rays incident to the printing tape, not only the images recorded on the tape but also the non-printed background in the tape where nothing is recorded, are well protected against deterioration and/or discoloration due to the ultraviolet rays, even if the tape is exposed to the ultraviolet rays for a long time of use.

In a preferred embodiment according to the second aspect of the present invention, the printing tape further comprises: a support layer; an adhesive layer provided over one of opposite major surfaces of the support layer; and a removable sheet provided over the adhesive layer, the heat-sensitive layer being provided over the other major surface of the support layer, the removable sheet being removed when the printing tape is used, so that the printing tape is adhered to an object via the adhesive layer and so that ultraviolet rays are incident to the heat-sensitive layer in the printing tape adhered in use to the object.

In another embodiment according to the second aspect of the present invention, the heat-sensitive layer contains a photostabilizing agent in addition to the heat-sensitive chromogenic material and the ultraviolet absorbing agent.

In yet another embodiment according to the second aspect of the present invention, the printing tape further comprises an overcoat layer provided over the heat-sensitive layer.

According to a third aspect of the present invention, there 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 such as characters on the printing tape, comprising: a housing; a tape spool disposed inside the housing such that the tape spool is rotatable; and the printing tape being wound around the tape spool, the printing tape comprising a support layer, an adhesive layer provided over one of opposite major surfaces of the support layer, a removable sheet provided over the adhesive layer, a heat-sensitive layer provided over the other major surface of the support layer, the heat-sensitive layer containing a heat-sensitive chromogenic material, and producing the images when being heated by the thermal head, and an ultraviolet absorbing layer provided over the heat-sensitive layer, the ultraviolet absorbing layer containing an ultraviolet absorbing agent, the removable sheet being removed when the printing tape is used, so that the printing tape is adhered to an object via the adhesive layer and so that ultraviolet rays are incident to the ultraviolet absorbing layer located over the heat-sensitive layer in the printing tape adhered in use to the object.

Since the heat-sensitive chromogenic layer itself of the printing tape develops color when being heated by the thermal head of the printer, no printer ribbon is needed for recording images on the printing tape. This leads to reducing the number of parts received or disposed in the recording-tape cartridge, thereby simplifying the overall construction of the cartridge.

In a preferred embodiment according to the third aspect of the present invention, the printing tape further comprises a barrier layer interposed between the heat-sensitive layer and the ultraviolet absorbing layer.

In another embodiment according to the third aspect of the present invention, the printing tape further comprises an overcoat layer provided over the ultraviolet absorbing layer.

In yet another embodiment according to the third aspect of the present invention, the heat-sensitive layer contains a photostabilizing agent in addition to the heat-sensitive chromogenic material.

According to a fourth aspect of the present invention, there 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 such as characters on the printing tape, comprising: a housing; a first and a second tape spool disposed inside the housing such that each of the first and second tape spools is rotatable; a first tape wound around the first tape spool, the first tape comprising a support layer, a first adhesive layer provided over one of opposite major surfaces of the support layer, a second adhesive layer provided over the other major surface of the support layer, and a removable paper provided over the first adhesive layer; and a second adhesive layer provided over the other major surface of the support layer, and a removable sheet provided over the first adhesive layer; and a second tape wound around the second tape spool, the second tape comprising a heat-sensitive layer containing a heat-sensitive chromogenic material, the heat-sensitive layer producing the images when being heated by the thermal head, and an ultraviolet absorbing layer containing an ultraviolet absorbing agent, the ultraviolet absorbing layer being provided over one of opposite surfaces of the heat-sensitive layer, the second tape being adhered via the second adhesive layer to the first tape such that the other major surface of the heat-sensitive layer is opposite to the other major surface of the support layer, the adhered first and second tapes providing the printing tape, the removable sheet being removed when the printing tape is used, so that

the printing tape is adhered to an object via the first adhesive layer and so that ultraviolet rays are incident to the ultraviolet absorbing layer located over the one major surface of the heat-sensitive layer in the printing tape adhered in use to the object.

In a preferred embodiment according to the fourth aspect of the present invention, the ultraviolet absorbing layer contains a photostabilizing agent in addition to the ultraviolet absorbing agent.

In another embodiment according to the fourth aspect of the present invention, the second tape further comprises an overcoat layer provided over the other major surface of the heat-sensitive layer, the heat-sensitive layer being heated via the overcoat layer by the thermal head.

According to a fifth aspect of the present invention, there 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 such as characters on the printing tape, comprising: a housing; a tape spool disposed inside the housing such that the tape spool is rotatable; and a printing tape wound around the tape spool, the printing tape comprising a heat-sensitive layer containing a heat-sensitive chromogenic material, the heat-sensitive layer producing the images when being heated by the thermal head, the heat-sensitive layer containing an ultraviolet absorbing agent in addition to the heat-sensitive chromogenic material.

In a preferred embodiment according to the fifth aspect of the present invention, the printing tape further comprises: a support layer; an adhesive layer provided over one of opposite major surfaces of the support layer; and a removable sheet provided over the adhesive layer, the heat-sensitive layer being provided over the other major surface of the support layer, the removable sheet being removed when the printing tape is used, so that the printing tape is adhered to an object via the adhesive layer and so that ultraviolet rays are incident to the heat-sensitive layer in the printing tape adhered in use to the object.

In another embodiment according to the fifth aspect of the present invention, the heat-sensitive layer contains a photostabilizing agent in addition to the heat-sensitive chromogenic material and the ultraviolet absorbing agent.

In yet another embodiment according to the fifth aspect of the present invention, the printing tape further comprises an overcoat layer provided over the heat-sensitive layer.

The above and optional objects, features and advantages of the present invention will be better understood by reading the following detailed description of the presently preferred embodiments of the invention when considered in conjunction with the accompanying drawings, in which:

Fig. 1 is a cross-sectional view of a printing tape A in accordance with the present invention;

Fig. 2 is a cross-sectional view of a printing tape B in accordance with the present invention;

Fig. 3 is a plan view of a lower half housing of a tape cartridge C in accordance with the present invention, with an upper half housing thereof being removed;

Fig. 4 is a perspective view of a tape-recording printer with which the cartridge of Fig. 3 is used;

Fig. 5 is a graph showing the results of measurements of the optical densities of the printed and non-printed portions of invention sample No. 1 and comparative sample No.1;

Fig. 6 is a plan view of a lower half housing of a conventional tape cartridge D, with an upper half housing thereof being removed, which cartridge is utilized for producing comparative sample No. 1;

Fig. 7 is a cross-sectional view of a printing tape E in accordance with the present invention;

Fig. 8 is a plan view of a lower half housing of a tape cartridge X in accordance with the present invention, with an upper half housing thereof being removed;

Fig. 9 is a perspective view of a tape-recording printer with which the cartridge of Fig. 8 is used;

Fig. 10 is a graph showing the results of measurements of the optical densities of the printed and non-printed portions of invention sample No.3 and comparative sample No.3;

Fig. 11 is a cross-sectional view of a printing tape F in accordance with the present invention;

Fig. 12 is a plan view of a lower half housing of a tape cartridge Y in accordance with the present invention, with an upper half housing thereof being removed;

Fig. 13 is a graph showing the results of measurements of the optical densities of the printed and non-printed portions of invention sample No.4 and comparative sample No.4;

Fig. 14 is a cross-sectional view of a printing tape G in accordance with the present invention;

Fig. 15 is a plan view of a lower half housing of a tape cartridge Z in accordance with the present invention, with an upper half housing thereof being removed;

Fig. 16 is a graph showing the results of measurements of the optical densities of the printed and non-printed portions of invention sample No.5 and comparative sample No.5;

Fig. 17 is a cross-sectional view of a printing tape H in accordance with the present invention;

Fig. 18 is a plan view of a lower half housing of a tape cartridge Q in accordance with the present invention, with an upper half housing thereof being removed;

Fig. 19 is a graph showing the results of measurements of the optical densities of the printed and non-

printed portions of invention sample No.6 and comparative sample No.6;

Fig. 20 is a cross-sectional view of a printing tape J in accordance with the present invention;

Fig. 21 is a plan view of a lower half housing of a tape cartridge S in accordance with the present invention, with an upper half housing thereof being removed; and

Fig. 22 is a graph showing the results of measurements of the optical densities of the printed and non-printed portions of invention sample No.7 and comparative sample No.7.

Referring to Fig. 1, there is shown a first embodiment, A, of a printing tape according to the present invention.

The printing tape A includes a heat-sensitive or thermal chromogenic layer 2 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 later).

The leuco-dye suitable for the thermal chromogenic layer 2 is preferably selected from

(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-orthochloroanilinofluoran,

3-diethylamino-7,8-benzofluoran,

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

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-methyl-7-anilinofluoran,

2-anilino-6-diethylaminofluoran, and

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

(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 B lactam, and

acid Rhodamine B sultone, and

(e) spiropyran dyes such as

benzo-β-naphthospiropyran, and

1,3,3-trimethyl-6'-chloro-8'-methoxy-indolinobenzospiropyran.

The color developer suitable for the thermal chromogenic layer 2 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 (i.e., bisphenol A),

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-hydroxydiphenoxide,
2,2'-dihydroxydiphenol
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, and
other phenolic polymers.

The reaction promoter suitable for the thermal chromogenic layer 2 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 2 is preferably selected from polyvinyl alchol, starch, denatured starch, derivatives of starch, methyl cellulose, hydroxyethyl cellulose, carboxymethyl cellulose, gum arabi, gelatin, casein, polyvinyl pyrrolidone, polyacrylamide, salt of polyacrylic acid, copolymer of styrene and maleic anhydride, copolymer of isobutylene and maleic anhydride, copolymer of styrene and butadiene, polyvinyl acetate, and ester of polyacrylic acid.

The composition used for forming the thermal chromogenic layer 2 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.

The printing tape A further includes a first support substrate or layer 1, on which the thermal chromogenic layer 2 is formed of the above-described composition. The first support layer 1 is preferably formed of a transparent or translucent plastic film such as polyester film, polyamide film, polypropylene film, or vinyl chloride film.

The first support layer 1 contains an ultraviolet absorbing agent which is preferably mixed by kneading with the raw material of the above-described plastic film. Thus, the first support layer 1 serves as the ultraviolet absorbing layer of the printing tape A. The ultraviolet absorbing agent 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-t-butyl-5-methyl-2-hydroxyphenyl)-5-chloro-benzotriazole,
2-(3,5-di-t-butyl-2-hydroxyphenyl)-5-chlorobenzotriazole,
and 2-(3,5-di-t-amyl-2-hydroxyphenyl)benzotriazole.

The first support layer 1 further contains a photostabilizing agent in addition to the ultraviolet absorbing agent. The photostabilizing agent is preferably selected from hindered amine compounds such as
bis(2,2,6,6-tetramethyl-4-piperidyl) sebacate,
bis(1,2,2,6,6-pentamethyl-4-piperidyl) sebacate,
1-[2-[3-(3,5-di-t-butyl-4-hydroxyphenyl)propionyloxy]ethyl]-4-[3-(3,5-di-t-butyl-4-hydroxyphenyl)propionyloxy]-2,2,6,6-tetramethylpiperidine,
8-benzyl-7,7,9,9-tetramethyl-3-octyl-1,3,8-triazaspiro[4.5]-decane-2,4-dione,
4-benzoyloxy-2,2,6,6-tetramethylpiperidine,
condensation polymerization product of dimethyl succinate and 1-(2-hydroxyethyl)-4-hydroxy-2,2,6,6-tetramethylpiperidine,
poly[[6-(1,1,3,3-tetramethylbutyl)imino-1,3,5-triazine-2,4-diyl][(2,2,6,6-tetramethyl-4-piperidyl)imino]hexamethylene-[(2,2,6-tetramethyl-4-piperidyl)imino]], and
bis(1,2,2,6,6-pentamethyl-4-piperidyl) 2-(3,5-di-t-butyl-4-hydroxybenzyl)-2-n-butylmalonate.

Referring to Fig. 2, there is shown a second embodiment, B, of a printing tape according to the present invention. The printing tape B includes an overcoat layer P in addition to a first support layer 1 and a thermal chromogenic layer 2 which are the same as the counterparts 1, 2 of the printing tape A of Fig. 1. The overcoat

layer P is provided over the thermal chromogenic layer 2 to protect the chromogenic layer 2 against an adhesive (described later). The overcoat layer P is preferably formed of polyvinyl alchol, methyl cellulose, ethyl cellulose, carboxymethyl cellulose, polyvinyl pyrrolidone, polyacrylamide, starch, gelatin, or methoxy cellulose. For protecting the chromogenic layer 2 against water or moisture, the overcoat layer P further contains an anti-water agent such as formalin, glyoxal, chrome alum, melamine, melamine formalin, polyamide resin, or polyamide epichlorhydrin resin.

In addition to a first tape, T, constituted by the first support layer 1 and thermal chromogenic layer 2 for the printing tape A, or in addition to a first tape, V, constituted by the first support layer 1, thermal chromogenic layer 2 and overcoat layer P for the printing tape B, each of the tapes A, B includes a second tape, U, consisting of a double coated adhesive tape 3, 4, 5 and a removable sheet 6 provided over a first adhesive layer 5.

Specifically, the second tape U includes a second support substrate or layer 4. The second support layer 4 is preferably formed of a Japanese paper, polyethylene film, polyester film, polypropylene film, or cellophane film. The first adhesive layer 5 and a second adhesive layer 3 are provided over opposite major surfaces of the second support layer 4, respectively. The adhesive used for forming the two adhesive layers 3, 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, opposite surfaces of a glassine paper, woodfree paper, craft paper, polyethylene-laminated sheet, or polyester film. Before the two adhesive layers 3, 5 are formed on the second support layer 4, an ink such as rotogravure ink or flexo graphic ink may be applied or used, as needed, on the support layer 4 to color the support layer 4 or print a color pattern on the same. In these cases, characters and/or other images recorded on the printing tape A, B clearly define themselves in the colorful background.

For producing each of the printing tapes A and B, 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 2. 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 first support layer 1. Subsequently, the applied material is dried by being subjected to hot air, so that the chromogenic layer 2 is formed on the support layer 1. Thus, the first tape T of the printing tape A of Fig. 1 is produced. For producing the first tape V of the printing tape B of Fig. 2, an overcoat material is additionally applied onto the chromogenic layer 2 by using the above-mentioned coating device, and dried into the overcoat layer P. The overcoat layer P effectively protects the chromogenic layer 2 against the adhesive of the adhesive layer 3 of the second tape U, even if the adhesive could adversely affect the chromogenic layer 2.

The second tape U of each of the printing taps A, B is produced by (a) applying an adhesive, by using the above-mentioned coating device, to one surface of the second support layer 4 (onto which a rotogravure ink, for example, may have been applied); (b) adhering the removable sheet 6 onto the adhesive which has been dried into the first adhesive layer 5; and (c) applying and drying the adhesive into the second adhesive layer 3 on the other surface of the support layer 4. Alternatively, the removable sheet 6 on which an adhesive has been applied and dried into the first adhesive layer 5 may be adhered to one surface of the second support layer 4, and subsequently an adhesive may be applied to, and dried on, the other surface of the second support layer 4 so as to provide the second adhesive layer 3.

Example 1

An example of the printing tape A including the first tape T and the second tape U, is produced as follows:

I. Production Of First Tape T

(1) Formation Of First Support Layer 1

The following composition is prepared as the material for forming the first support layer 1:

	(parts by weight)
COMPOSITION FOR FIRST SUPPORT LAYER 1	
1. Polymer	
Raw chips of polyethylene terephthalate	- 100
2. Ultraviolet absorbing agent	
2-(5-methyl-2-hydroxyphenyl)benzotriazole	- 2

The above materials are mixed with each other, melted and kneaded in an extruder, and subsequently extruded using a T-die. Then, the extruded material is subjected, while being heated, to biaxial stretching to provide the first support layer 1 in the form of a polyester film.

(2) Preparation Of Material For Thermal Chromogenic Layer 2

For preparing the coating material for forming the thermal chromogenic layer 2, first, a liquid, A, and a liquid, B, are prepared which have the following compositions, respectively:

	(parts by weight)
LIQUID A	
1. Leuco-dye	
3-diethylamino-6-methyl-7-anilinofluoran	- 5
2. Binder	
15% aqueous solution of polyvinyl alcohol	- 45
3. Water	- 50
LIQUID B	
1. Color developer	
bisphenol A	- 10
2. Reaction promoter	
stearic acid amide	- 5
3. Binder	
15% aqueous solution of polyvinyl alcohol	- 35
4. Water	- 50

After the liquids A and B are prepared, each of the two liquids is homogenized using a ball mill, separately from each other, for forty eight 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 2.

(3) Application Of The Coating Material

The thus obtained coating material is applied using a gravure roll to one of opposite major surfaces of the first support layer 1, to an amount or thickness of 10 g/m^2 after being dried. The applied material is dried into the thermal chromogenic layer 2. Thus, the first tape T for the printing tape A is produced.

II. Production Of Second Tape U

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

ADHESIVE	(unit: g)
1. Oil and fat	- 100
(Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	
2. Isocyanate-type hardener	- 2
(B-45 from Ipposha Oil Industries Co. Ltd., Japan)	
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 6 formed of a 60 μm thick paper (DGN-70 available from San-ei Kagaku Kogyo K.K., Japan) whose surfaces have been coated with silicone. Thus, the first adhesive layer 5 is formed on the removable sheet 6, to an amount or thickness of 20 g/m^2 after sufficiently being dried at 120 °C.

Next, a 12 μm thick polyester film (S-12 available from Teijin Ltd., Japan) is adhered to the first adhesive layer 5 to provide the second support sheet 4. Subsequently, the same adhesive is applied under the same conditions onto the second support sheet 4, and dried at 120 °C to provide the second adhesive layer 3. Thus, the second tape U for the priring tape A is produced.

III. Production Of Printed Samples No.1

Hereinafter, by reference to Figs. 3 and 4, there will be described the manner of production of printed samples No.1 by using the printing tape A, i.e., thus obtained first and second tapes T, U. Fig. 3 is a plan view of a lower half housing 11 of a tape cartridge, C, with an upper half housing (not shown) being removed, and Fig. 4 is a perspective view of a tape-recording printer 20 which includes a thermal head 15 for thermally recording images on a length of the printing tape A.

First, the first tape T produced as described above is cut into a 12 mm width web. Subsequently, the thus obtained first tape T is wound around a first tape spool 10 having a 12 mm outer diameter and a 12 mm height, such that the first support layer 1 is located outside and the thermal chromogenic layer 2 is located inside. The first tape spool 10 is accommodated in the lower housing 11, as shown in Fig. 3, such that the first tape spool 10 is rotatably supported by the lower housing 11 and the upper housing (not shown).

Next, like the first tape T, the second tape U is cut into a 12 mm width web, and is wound around a second tape spool 23 such that the removable sheet 6 is located on the outermost side. The second tape spool 23 is incorporated in the lower housing 11, as shown in Fig. 3, such that like the first tape spool 10, the second tape spool 23 is rotatably supported by the cooperation of the upper and lower housings of the tape cartridge C.

In the lower half housing 11, the first tape T is fed from the first tape spool 10 to a printing section 13 via a tape guide member 12. The feeding of the first 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 each are rotatably supported by the roller support member 16. When the thermal head 15 records characters and/or other images on the printing tape A, more specifically, first tape T thereof, 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 2 of the first 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 A or first tape T out of the cartridge C.

Meanwhile, the second tape U, i.e, double coated adhesive tape including the removable sheet 6 is fed from the second tape spool 23 and guided to the tape feed roller 14. The second tape U is pinched together

with the printed first tape T between the presser roller 18 and the tape feed roller 14. The two tapes T and U are pressed by the two rollers 18, 14 so as to be adhered to each other. Thus, the printing tape A constituted by the first and second tapes T, U is obtained as a printed sample No.1. The printed sample No.1 is outputted from 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. 4) 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 2 of the first tape T. The chromogenic material reacts with the color developer and thereby develops color, in the heated areas of the chromogenic layer 2. Thus, laterally reversed or mirror images are imprinted in the chromogenic layer 2 of the first tape T.

Described again, the first tape T after being printed, i.e., printed first tape T is adhered to the second tape U by the cooperation of the presser roller 18 and the tape feed roller 14. The thus produced printing tape A, consisting of the printed first tape T and the second tape U, is outputted from the tape cartridge C. The outputted tape A is cut by a cutting blade (not shown), and is used as the printed sample No.1. Three printed samples No.1 are obtained at respective ambient temperatures of 35°C, 20°C, and 5°C.

IV. Production Of Printed Samples No.2

Next, printed samples No.2 are produced using the printing tape B of Fig. 2, generally in the same manner as described above with respect to the production of printed samples No.1.

First, the first tape V shown in Fig. 5 is produced. The structure of the first tape V is generally similar to that of the first tape T used for producing the printed samples No.1 (i.e., printing tape A of Fig. 1), but is different from the first tape T in that the first tape V additionally includes the overcoat layer P provided over the thermal chromogenic layer 2 on the opposite side of the first support layer 1.

The overcoat layer P is formed after the thermal chromogenic layer 2 is formed on the first support layer 1.

(1) Formation Of Overcoat Layer P

First, a liquid for the overcoat layer P is prepared which has the following composition:

LIQUID FOR OVERCOAT LAYER P	(parts by weight)
1. 15% aqueous liquid of polyvinyl alcohol	- 80
2. melamine resin	- 5

The above constituents are sufficiently mixed with each other and agitated. The thus obtained aqueous solution is applied onto the thermal chromogenic layer 2 to an amount or thickness of 3 g/m^2 as measured after being dried. Thus, the first tape V for the printin tape B is produced.

(2) Production Of Printed Samples No.2

The thus obtained first tape V is accommodated in a lower half housing 11 of a tape cartridge C in the same manner as described above for the printed samples No.1. The same second tape U as that used for the printed samples No.1 is mounted in the lower housing 11, and the thus obtained cartridge C is inserted in the tape receiving area 22 of the printer 20 of Fig. 4. Similarly, the thermal head 15 records laterally reversed characters and/or other images by selectively heating, and thereby coloring, the thermal chromogenic layer 2 of the first tape V. The adhesive second tape U is adhered to the thus printed first tape V, and a printed sample No.2 is produced. Similar to the printed samples No.1, three printed samples No.2 are obtained at respective ambient temperatures of 35°C, 20°C, and 5°C.

V. Production Of Comparative Printed Samples No.1 & No.2

(1) Production Of Comparative Printed Samples No.1

For carrying out various comparative tests on the printed samples No.1 and No.2, first, comparative printed samples No.1 are produced. A comparative first tape used for producing the comparative printed samples No.1

is basically the same as that of the first tape T used for producing the invention printed samples No.1, but is different from the latter in that the former does not contain an ultraviolet absorbing agent in a first support layer thereof. The comparative printed samples No.1 are produced, like the invention printed samples No.1, by (a) incorporating the comparative printing tape and a second tape U into a tape cartridge C shown in Fig. 3; (b) inserting the cartridge C in the printer 20 shown in Fig. 4; (c) and operating the thermal head 15 to effect desired printing on the comparative first tape. No further detailed description is provided. Likewise, three comparative printed samples No.1 are produced at respective ambient temperatures of 35°C, 20°C, and 5°C.

(2) Production Of Comparative Printed Samples No.2

Comparative printed samples No.2 are produced by the "laminating" type printer disclosed in the above-identified Japanese Utility Model Application laid open under Publication No. 1(1989)-104359.

(i) Production Of Printer Ribbon

First, an ink is prepared which has the following composition and has a viscosity of 270 cps at 95 °C.

COMPOSITION OF RIBBON INK	(parts by weight)
1. Copolymer of α-olefin and maleic anhydride (Diacarna 30 from Mitsubishi Kasei Kogyo K.K., Japan)	- 3
2. Candelilla wax (Candelilla wax 2698 from Chukyo Yushi K.K., Japan)	- 5
3. Rosin ester (Super Ester A-100 from Arakawa Kagaku Kogyo K.K., Japan)	- 3
4. Copolymer of ethylene and vinyl acetate (EVA 210 from Mitsui DuPont Chemical K.K., Japan)	- 3
5. Carbon black (Ma-7 from Mitsubishi Kasei Kogyo K.K., Japan)	- 3
6. Methyl isobutyl ketone (solvent)	- 100

The ink is applied to a 3.5 μm thick PET (polyethylene terephthalate) film such that after drying of the ink, the ink layer has a 6 to 7 μm thickness. Thus, a printer ribbon, R, is produced.

(ii) Production Of Comparative Printed Samples No.2

A polyethylene film is slit into a web-like tape which in turn is wound around a core. Thus, a comparative first tape, W, is produced. The first tape W and the printer ribbon R are accommodated in a tape cartridge, D, as shown in Fig. 6. The tape cartridge D is used with the above-described "laminating" type printer.

The construction of the tape cartridge D is as follows: Fig. 6 is a plan view of a lower half housing 30 of the cartridge D with an upper half housing (not shown) being removed. A first tape spool 31, on which the first tape W is wound, is disposed in the lower half housing 31 such that the first tape spool 31 is rotatably supported by the cooperation of the lower and upper housings. The first tape W is fed from the first tape spool 31 to a printing section 33 via a tape guide member 32. The first tape W is outputted from the cartridge D by a tape feed roller 36 which is driven or rotated by a tape feed shaft of the "laminating" type printer.

The printer ribbon R is wound on a ribbon spool 34, and is fed from the ribbon spool 34 to the printing section 33 in the same manner as that for the first tape W. After being used in the printing section 33, the ribbon R is taken up by a ribbon take-up spool 35 which is driven or rotated by a ribbon take-up shaft of the "laminating" type printer.

A second tape (i.e., double coated adhesive tape) U is wound on a second tape spool 37 which is rotatably supported, like the first tape spool 31, by the cooperation of the upper and lower housings of the cartridge D.

The second tape U is fed from the second tape spool 37 and guided to the tape feed roller 36.

The tape cartridge D is inserted in a cartridge receiving area of the prior printer, and the thermal head of the machine is operated to print laterally reversed or mirror-image characters and/or other images on the first tape W via the printer ribbon R. Thus, a comparative printed sample No.2 is obtained. For comparing with the invention printed samples No.1 and No.2, three comparative printed samples No.2 are produced at respective ambient temperatures of 35°C, 20°C, and 5°C.

The thermal head, roller support member, etc. of the prior printer have the same functions as those of counterparts of the printer of Fig. 4, and therefore no description thereof is provided.

IV. Comparison Between Invention Printed Samples No.1, No.2 And Comparative Printed Samples No.1, No.2

Regarding each sample, printing characteristic (i.e., clearness of printed images) and feeding characteristic (i.e., smoothness of tape feeding in a tape cartridge) are measured, and the obtained results are compared with each other in TABLE.

TABLE

	PRINTING CHARACT-ERISTIC at 35°C	PRINTING CHARACT-ERISTIC at 20°C	PRINTING CHARACT-ERISTIC at 5°C	FEEDING CHARACT-ERISTIC
INVENTION SAMPLE No.1	A*1	A	B*2	a*4
INVENTION SAMPLE No.2	B	A	B	a
COMPARATIVE SAMPLE No.1	A	A	B	a
COMPARATIVE SAMPLE No.1	C*3	B	C	b*5

*1: Very clear
*2: Clear
*3: Slightly unclear
*4: Smooth feeding
*5: Feeding with slightly lowered smoothness

(i) Printing Characteristic

The printing characteristic of each sample is evaluated by visual observation. The invention printed samples No.1 produced at 35°C and 20°C enjoy very clearly printed images, while the invention sample No.1 produced at 5°C has a clearness usually without any problem. Further, the invention samples No.2 produced at 35°C and 5°C have a clearness usually without any problem, while the invention sample No.2 produced at 20°C enjoys very clearly printed images.

It emerges from the above results that the thermal chromogenic layers 2 of the first tapes T, V of the printing tapes A, B develop color with high stability, i.e., without adversely being affected by ambient temperatures. Stated differently, the printing tapes A, B used for producing the invention samples No.1, No.2 have excellent printing characteristic in the range of 5°C to 30°C ambient temperatures. In particular, the printing characteristic

of the printing tapes A, B is excellent when those tapes are used at 20°C at which the tapes A, B are most frequently used.

The comparative printed samples No.1 produced at 35°C and 20°C enjoy very high printing clearness, and the comparative sample No.1 produced at 5°C has a printing usually without any problem. Thus, with regard to the printing characteristic, the comparative samples No.1 are comparable to the invention examples No.1, No.2.

On the other hand, the comparative sample No.2 produced at 20°C has no particular problem with regard to the printing characteristic, but the comparative examples No.2 produced at 35°C and 5°C suffer from slight unclearness of the printed images. Since the ink of the ribbon R contains wax and carbon as essential constituents thereof and the melting point of wax is comparatively low, the ink can adversely be affected by the ambient temperatures.

Thus, it is concluded that the comparative samples No.2 exhibit a significant difference with regard to the printing characteristic over the invention samples No.1, No.2 and the comparative sample No.1.

(ii) Feeding Characteristic

With regard to feeding characteristic, the invention samples No.1, No.2 and the comparative sample No.1, each accommodated in the tape cartridge C of Fig. 3, show that the first tapes T, V are fed smoothly for printing, without any problem. On the other hand, the comparative sample No.2 incorporated in the tape cartridge D of Fig. 6 shows that the first tape W is not fed smoothly. Since the first tapes T, V have the thermal chromogenic layer 2 which produces color when heated by a thermal head and therefore no printer ribbon or no part for feeding the ribbon is provided in the cartridge C, the feeding of the tapes T, V cannot be interfered with by those members.

In contrast, regarding the comparative sample No.2, the printer ribbon R and the parts for feeding the ribbon R are necessarily provided in the cartridge D. Thus, those members may interfere with the feeding of the first tape W. In addition, since the thickness of the ribbon R is very small, e.g., about 10 μm, it is very difficult to feed the ribbon R with sufficient stability. When the ribbon R is fed for printing, the ribbon R may be jammed, which may interfere with the feeding of the first tape W. These problems can account for the above-indicated results with respect to the feeding characteristic of the comparative sample No.2.

Additionally, printing density is measured using a Macbeth densitometer regarding images recorded on each of the invention samples No.1, No.2 and comparative samples No.1, No.2 all of which are produced at an ambient temperature of 20°C. However, substantially no difference is observed among the tested samples.

(iii) Effect Of Ultraviolet Absorbing Agent

The effect of the ultraviolet absorbing agent contained in the first tape T of the invention sample No.1 is evaluated in comparison with the comparative sample No.1 wherein no such agent is contained in the support layer of the comparative first tape thereof. The comparison test is carried out by measuring the optical density of each of the printed (colored) portion where images have been printed, and the non-printed portion or background where no printing has been made, regarding each of the first tapes of the invention sample No.1 and comparative sample No.1. The test results are shown in the graph of Fig. 5.

The abscissa of the graph of Fig. 5 represents the UV exposure time in which each sample is exposed to ultraviolet rays (UV), and the ordinate of the graph represents the measured optical densities. The measurement of optical density is carried out by exposing each sample to 300 to 400 nm wavelength UV rays having an irradiance of 50 W/m^2, for one hundred and eight hours, and measuring the optical densities of the printed and non-printed portions of each sample at every 36 hours. More specifically, a colorimeter (CM-2002 available 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 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. 5, symbol "triangle" indicates the optical densities of the printed portion of the invention sample No.1; symbol "plus" indicates the optical densities of the non-printed portion of the invention sample No.1; symbol "diamond" indicates the optical densities of the printed portion of the comparative sample No.1; and symbol "square" indicates the optical densities of the non-printed portion of the comparative sample No.1.

The graph of Fig. 5 shows that the optical densities of the printed portion of the invention sample No.1 are changed from 1.23 to 1.02 during the 108 hour UV exposure and therefore the density change is only 0.21 whereas the optical densities of the printed portion of the comparative sample No.1 are changed from 1.23 to 0.70 under the same conditions and the density change is 0.53 much greater than 0.21. It is speculated that since the first tape of the comparative sample No.1 does not contain any ultraviolet absorber, the color images

on the chromogenic layer 2 have discolored due to the exposure to the ultraviolet rays. Although discoloration occurs to some degree regarding the images recorded on the invention sample No.1, that degree is much lower than that of the comparative sample No.1 because the support layer 1 of the first tape T of the invention sample No.1 contains the ultraviolet absorbing agent.

The graph of Fig. 5 also shows the comparison between the optical densities of the non-printed portions of the invention sample No. 1 and comparative sample No.1. Specifically, the optical densities of the non-printed portion of the invention sample No.1 are changed from 0.08 to 0.19 during the 108 hour UV exposure and thus the density change is only 0.11 whereas the optical densities of the non-printed portion of the comparative sample No.1 are changed from 0.08 to 0.45 under the same conditions and the density change is 0.37 much greater than 0.11. It is estimated that since the first tape of the comparative sample No.1 does not contain any ultraviolet absorber, the support layer of. the comparative first tape has become yellowish due to the exposure to the ultraviolet rays. Although yellowing occurs to some degree regarding the non-printed portion of the first tape T as the invention sample No.1, that degree is much lower than that of the comparative sample No.1 because the support layer 1 of the first tape T of the invention sample No.1 contains the ultraviolet absorbing agent.

Thus, the ultraviolet absorbing agent contained in the support layer 1 of the first tape T of the invention sample No. 1 effectively protects, against ultraviolet rays, not only the printed (colored) portion but also the non-printed portion of the chromogenic layer 2 of the first tape T.

As is apparent from the foregoing description, the printing tapes A, B including the first tapes T, V in accordance with the present invention contain an ultraviolet absorbing agent in the first support layer 1 thereof and therefore not only the printed portion but also the non-printed portion of the first tapes T, V are effectively protected against ultraviolet rays. Thus, discoloration of the printed portion is minimized, and discoloration or yellowing of the non-printed portion is prevented. The printing tapes A, B can be used for a long time with stability, e.g., without deterioration of the images recorded on the first tapes T, V.

In addition, the first tapes T, V of the printing tapes A, B include a heat-sensitive or thermal chromogenic layer 2 provided on the first support layer 1 thereof. The thermal chromogenic layer 2 produces color images with high stability, without adversely being affected by ambient temperatures, when the chromogenic layer 2 is heated by a thermal head of a printer. Thus, characters and/or other images are recorded on the printing tapes A, B with high clearness and with high printing quality. That is, the printing tapes A, B enjoy high printing characteristic.

Meanwhile, the tape cartridge C of Fig. 3 accommodates the printing tape A or B including, on the support layer 1 of the first tape T or V, a heat-sensitive or thermal chromogenic layer 2 which produces color images with high stability, without adversely being affected by ambient temperatures, when the chromogenic layer 2 is heated by a thermal head of a printer. Thus, the cartridge C does not need a printer ribbon or any parts for feeding the ribbon. Therefore, the overall construction of the cartridge C is simplified. Additionally, the feeding of the first tape T, V is effected with smoothness, without being interfered with by the feeding of a ribbon. Furthermore, the number of the parts necessary for constituting the cartridge C is reduced, and thus the cartridge C is produced at reduced cost.

Referring next to Fig. 7, there is shown a third embodiment, E, of a printing tape in accordance with the present invention.

The printing tape E includes a heat-sensitive or thermal chromogenic layer 102 which is preferably formed of the previously-described composition used for forming the thermal chromogenic layer 2 of the printing tape A or B of Fig. 1 or Fig. 2. No further description of the chromogenic layer 102 of the printing tape E is provided.

The printing tape E further includes an overcoat layer 101 for protecting the thermal chromogenic layer 102. The overcoat layer 101 is preferably formed of one of the previously-described materials used for forming the overcoat layer P of the printing tape B.

In the third embodiment, the overcoat layer 101 contains an ultraviolet absorbing agent which is preferably selected from the previously-described derivatives of benzotriazole used for being dispersed in the first support layer 1 of the printing tape A or B. Thus, the overcoat layer 101 serves as the ultraviolet absorbing layer of the printing tape E. For protecting the chromogenic layer 102 against water or moisture, the overcoat layer 101 further contains an anti-water agent which is preferably selected from the previously-described substances used for the overcoat layer P of the printing tape B.

The printing tape E further includes a support layer 103, an adhesive layer 104, and a removable sheet 105. The support layer 103 is preferably formed of a plastic film such as polyester film, polyamide film, polypropylene film, or vinyl chloride film; or a paper such as or woodfree paper or Japanese paper. The adhesive layer 104 is preferably formed of one of the previously-described adhesives used for forming the adhesive layers 3, 5 of the printing tape A or B. The removable sheet 105 is preferably produced by coating, with silicone, one of opposite major surfaces of a glassine paper or a polyethylene terephthalate (PET) film.

The removable sheet 105 is provided over one of opposite major surfaces of the support layer 103 via the adhesive layer 104 provided therebetween, and the thermal chromogenic layer 102 is provided by coating over the other major surface of the support layer 103. Additionally, the overcoat layer 101 containing the ultraviolet absorbing agent dispersed therein, is provided over the thermal chromogenic layer 102.

Example 2

I. Production Of Printing Tape E

An example of the printing tape E constructed as described above is produced as follows:

(1) Formation Of Support Layer 103

A 38 μm thick polyester film (S-38 available from Teijin Ltd., Japan) is used as the support layer 103.

(2) Preparation Of Material For Chromogenic Layer 102

For preparing the coating material for forming the thermal chromogenic layer 102, first, a liquid, A, and a liquid, B, are prepared which have the following compositions, respectively:

(unit: g)

LIQUID A	
1. Leuco-dye	
3-diethylamino-6-methyl-7-anilinofluoran	- 5
2. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
3. Water	- 100
LIQUID B	
1. Color developer	
bisphenol A	- 10
2. Reaction promoter	
stearic acid amide	- 7
3. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
4. Water	- 100

After the liquids A and B are prepared, each of the two liquids is homogenized using a ball mill, separately from each other. Subsequently, 100 g of each of the liquids A and B, 50 g of epoxy-modified polyvinyl alcohol,

and 50 g of water are mixed and agitated to provide the coating material for forming the thermal chromogenic layer 102.

(3) Application Of The Coating Material

The thus obtained coating material is applied to one of the opposite major surfaces of the support layer 103, to an amount or thickness of 10 g/m^2. The applied material is dried into the chromogenic layer 102.

(4) Formation Of Overcoat Layer 101

The following composition is prepared as the material for forming the overcoat layer 101:

	(unit: g)
1. 20% solution of epoxy-modified polyvinyl alcohol	- 40
2. Ultraviolet absorbing agent	
2-(3-tert-butyl-5-methyl-2-hydroxyphenyl)-	- 2
5-chlorobenzotriazole	
3. Water	- 100

The thus obtained material is applied by gravure coating onto the exposed surface of the chromogenic layer 102 formed on the support layer 103, to an amount or thickness of 1 g/m^2. The applied material is dried into the overcoat layer 101.

(5) Formation Of Adhesive Layer 104 And Removable Sheet 105

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

ADHESIVE	(unit: g)
1. Oil and fat	- 100
(Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	
2. Oil and fat	- 2
(Oil and fat B-45 from Ipposha Oil Industries Co. Ltd., Japan)	
3. Ethyl acetate	- 30

The above compounds are mixed and agitated to provide an adhesive, which is applied to the silicone-coated surface of the 60 μm thick removable sheet 105, to an amount or thickness of 20 g/m^2. The applied adhesive is dried into the adhesive layer 104 on the removable sheet 105.

(6) Production Of Printing Tape E

The removable sheet 105 is adhered via the adhesive layer 104 to the other major surface of the support layer 103 on the opposite side of the thermal chromogenic layer 102 and overcoat layer 101. Thus, the printing tape E is produced.

II. Production Of Printed Sample No.3

Hereinafter, by reference to Figs. 8 and 9, there will be described the manner of production of a printed sample No.3 by using the printing tape E. Fig. 8 is a plan view of a lower half housing 111 of a tape cartridge, X, with an upper half housing (not shown) being removed, and Fig. 9 is a perspective view of a tape-recording printer 120 which includes a thermal head 115 for thermally recording images on a length of the printing tape E fed from the tape cartridge X set in the printer 20.

First, the printing tape E produced as described above is cut into a 12 mm width web. Subsequently, the printing tape E is wound around a first tape spool 110 having a 12 mm outer diameter and a 12 mm height, such that the removable sheet 105 is located on the outermost side. The first tape spool 110 is accommodated in the lower housing 111, as shown in Fig. 8, such that the first tape spool 110 is rotatably supported by the lower housing 111 and the upper housing (not shown).

In the lower half housing 111, the printing tape E is fed from the first tape spool 110 to a printing section 113 via a tape guide member 112. The feeding of the printing tape E is effected by a tape feed roller 114 which is driven, with the cartridge X being set in a cartridge-receiving area 122 of the printer 120 of Fig. 9, by a tape feed shaft 121 of the printer 120. With the cartridge X being set in the printer 120, the thermal head 115 of the printer 120 is located in the printing section 113.

When the thermal head 115 of the printer 120 records "normal" (not "mirror") images in the printing tape E, more specifically, thermal chromogenic layer 102 thereof, a roller support member 116 of the printer 120 is rotated counterclockwise about an axis member 119. Thus, a platen roller 117 is pressed against the thermal head 115, so that the thermal head 115 stably records images in the thermal chromogenic layer 102 of the printing tape E. Concurrently, a presser roller 118 is pressed against the tape feed roller 114 of the cartridge X, so that the two rollers 118, 114 cooperate with each other to feed the thus printed length of the printing tape X.

The tape cartridge X is inserted in the tape receiving area 122 provided in the rear section (i.e., in the right-hand portion as seen in Fig. 9) of the printer 120. Electric current is selectively applied to the individual heat generating elements of the thermal head 115, so that the thermal head 115 heats, via the overcoat layer 101, selected areas of the thermal chromogenic layer 102 of the printing tape E. Consequently, the chromogenic material reacts with the color developer and develops color, in the heated areas of the chromogenic layer 102. Thus, desired images such as characters are recorded in the printing tape E.

The printed length of the printing tape E is outputted from the cartridge X by the cooperation of the presser roller 118 and the tape feed roller 114. The outputted length of the tape E is cut by a cutting blade (not shown), and is used as a printed sample No.3.

III. Production Of Comparative Printed Sample No.3

For carrying out comparison with the thus obtained printed sample No.3, a comparative printed sample No.3 is produced. The comparative printed sample No.3 is produced by using a comparative printing tape having basically the same structure as that of the printing tape E used for producing the invention printed sample No.3, but is different from the latter in that the former does not contain an ultraviolet absorbing agent in the overcoat layer thereof. The comparative printed sample No.3 is produced, like the invention printed sample No.3, by incorporating the comparative tape into a tape cartridge X of Fig. 8, inserting the cartridge X in the printer 120 of Fig. 9, and operating the thermal head 115 to effect desired printing on the comparative tape.

IV. Comparison Between Invention Printed Sample No.3 And Comparative Printed Sample No.3

The effect of the ultraviolet absorbing agent contained in the overcoat layer 101 of the invention sample No.3 is evaluated in comparison with the comparative sample No.3 wherein no such agent is contained in the overcoat layer thereof. The comparison test is carried out by measuring the optical density of each of the printed or colored portion where images have been printed, and the non-printed portion or background where no printing has been made, with respect to each of the invention sample No.3 and comparative sample No.3. The comparison test results are shown in the graph of Fig. 10.

The abscissa of the graph of Fig. 10 represents the UV exposure time in which each sample is exposed to ultraviolet rays (UV), and the ordinate of the graph represents the measured optical densities. The measurement of optical density is carried out by exposing each sample to 300 to 400 nm wavelength UV rays having an irradiance of 50 W/m^2, for seventy two hours, and measuring the optical densities of each of the printed and non-printed portions of each sample at every 24 hours. The other details of the test are the same as the previously-described test performed for comparing the invention sample No.1 with the comparative sample No.1.

The graph of Fig. 10 shows that the optical densities of the printed portion of the invention sample No.3 are changed from 1.23 to 1.01 during the 72 hour UV exposure and therefore the density change is only 0.22 whereas the optical densities of the printed portion of the comparative sample No.3 are changed from 1.23 to 0.86 under the same conditions and the density change is 0.37 -much greater than 0.22. It is speculated that since the overcoat layer of the comparative sample No.3 does not contain any ultraviolet absorber, the color images produced on the chromogenic layer have discolored due to the exposure to the ultraviolet rays. Al-

though discoloration occurs to some degree regarding the images recorded on the invention sample No.3, that degree is much lower than that of the comparative sample No.3 because the overcoat layer 101 of the invention sample No.3 contains the ultraviolet absorbing agent.

The graph of Fig. 10 also shows the comparison between the optical densities of the non-printed portions of the invention and comparative samples No.3, No.3. Specifically, the optical densities of the non-printed portion of the invention sample No.3 are changed from 0.08 to 0.18 during the 72 hour UV exposure and thus the density change is only 0.10 whereas the optical densities of the non-printed portion of the comparative sample No.3 are changed from 0.08 to 0.30 under the same conditions and the density change is 0.22 much greater than 0.10. It is estimated that since the overcoat layer of the comparative sample No.3 does not contain any ultraviolet absorber, the non-printed portion of the comparative printing tape has become yellowish due to the exposure to the ultraviolet rays. Although yellowing occurs to some degree regarding the non-printed portion of the printing tape E as the invention sample No.3, that degree is much lower than that of the comparative sample No.3 because the overcoat layer 101 of the invention sample No.3 contains the ultraviolet absorbing agent.

Thus, the ultraviolet absorbing agent contained in the overcoat layer 101 of the printing tape E as the invention sample No.3 effectively protects, against ultraviolet rays, not only the printed (colored) portion but also the non-printed portion of the chromogenic layer 102 of the printing tape E.

As is apparent from the foregoing description, the printing tapes E in accordance with the present invention contains an ultraviolet absorbing agent in the overcoat layer 101 thereof, and therefore not only the printed portion but also the non-printed portion of the printing tape E are effectively protected against ultraviolet rays. Thus, discoloration of the printed portion is minimized, and discoloration or yellowing of the non-printed portion is prevented. The printing tape E can be used for a long time with stability, e.g., without deterioration of the images recorded thereon.

Meanwhile, the tape cartridge X of Fig. 8 accommodates the printing tape E which has, on one surface of the support layer 101, the chromogenic layer 102 and overcoat layer 101 formed in this order and, on the opposite surface of the support layer 101, the removable sheet 105 adhered thereto via the adhesive layer 104. Thus, the tape cartridge X does not need any printer ribbon or any parts for feeding the ribbon therein. Therefore, the overall construction of the cartridge X is simplified. Additionally, the feeding of the printing tape E is effected with stability or smoothness, without being interfered with by the feeding of the ribbon. Furthermore, the number of the parts necessary for constituting the cartridge X is reduced, and therefore the cartridge X is produced at reduced cost. Furthermore, since the overcoat layer 101 is provided over the thermal chromogenic layer 102 in which images such characters are produced, the images recorded in the printing tape E enjoy extremely enhanced abrasion resistance. That is, the printing tape E is very fast and secure.

Referring next to Fig. 11, there is shown a fourth embodiment, F, of a printing tape in accordance with the present invention.

The printing tape F includes a heat-sensitive or thermal chromogenic layer 203, and an overcoat layer 201 including an ultraviolet absorbing agent (thus, overcoat layer 201 serves as the ultraviolet absorbing layer of the printing tape F), and serving for protecting the thermal chromogenic layer 203. The printing tape F further includes a barrier layer 202, a support layer 204, an adhesive layer 205, and a removable sheet 206. The thermal chromogenic layer 203, support layer 204, adhesive layer 205, and removable sheet 206 are the same as the counterparts 102, 103, 104, 105 of the printing tape E of Fig. 7, and no further description thereof is provided.

The overcoat layer 201 is preferably formed of one of the previously-described materials used for forming the overcoat layer P of the printing tape B of Fig. 2. In the fourth embodiment, the overcoat layer 201 further contains an ultraviolet absorbing agent which is preferably selected from the previously-described derivatives of benzotriazole used for the first support layer 1 of the printing tape A or B.

The barrier layer 202 serves for preventing the chromogenic layer 203 from being influenced by the overcoat layer 201. The barrier layer 202 is preferably formed of polyvinyl alchol, methyl cellulose, ethyl cellulose, carboxymethyl cellulose, polyvinyl pyrrolidone, polyacrylamide, starch, gelatin, or methoxy cellulose. For protecting the chromogenic layer 203 against water or moisture, the overcoat layer 201 further contains an anti-water agent which is preferably selected from. the previously-described substances used for the overcoat layer P of the printing tape B.

The removable sheet 206 is provided over one of opposite major surfaces of the support layer 204 via the adhesive layer 205 provided therebetween, and the thermal chromogenic layer 203 is provided by coating over the other major surface of the support layer 204. Additionally, the barrier layer 202, and the overcoat layer 201 containing the ultraviolet absorbing agent, are provided over the thermal chromogenic layer 203 in the order of description.

Example 3

I. Production Of Printing Tape F

An example of the printing tape F constructed as described above is produced as follows:

(1) Formation Of Support Layer 204

A 38 μm thick polyester film (S-38 available from Teijin Ltd., Japan) is used as the support layer 204.

(2) Preparation Of Material For Chromogenic Layer 203

For preparing the coating material for forming the thermal chromogenic layer 203, first, a liquid, A, and a liquid, B, are prepared which have the following compositions, respectively:

	(unit: g)
LIQUID A	
1. Leuco-dye	
3-diethylamino-6-methyl-7-anilinofluoran	- 5
2. Binder	
20% solution of epoxy-modifed polyvinyl alcohol	- 40
3. Water	- 100
LIQUID B	
1. Color developer	
bisphenol A	- 10
2. Reaction promoter	
stearic acid amide	- 7
3. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
4. Water	- 100

After the liquids A and B are prepared, each of the two liquids is brought into dispersion separately from each other, using a ball mill. Subsequently, 100 g of each of the liquids A and B, 50 g of epoxy-modified polyvinyl alcohol, and 50 g of water are mixed and agitated to provide the coating material for forming the thermal chromogenic layer 203.

(3) Application Of The Coating Material

The thus obtained coating material is applied to one of opposite major surfaces of the support layer 204, to an amount or thickness of 10 g/m^2. The applied material is dried into the chromogenic layer 203.

(4) Formation Of Barrier Layer 202

The following composition is prepared as the material for forming the barrier layer 202:

	(unit: g)
1. 20% solution of epoxy-modified polyvinyl alcohol	- 40
2. Water	- 100

The thus obtained material is applied by gravure coating onto the exposed surface of the thermal chromogenic layer 203 formed on the support layer 204, to an amount or thickness of 1 g/m^2. The applied material is dried into the barrier layer 202.

(5) Formation Of Overcoat Layer 201

The following composition is prepared as the material for forming the overcoat layer 201:

	(unit: g)
1. 20% solution of epoxy-modified polyvinyl alcohol	- 40
2. Ultraviolet absorbing agent	
2-(3-tert-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole	- 2
3. Water	- 100

The thus obtained material is applied by gravure coating onto the exposed surface of the barrier layer 202 formed on the thermal chromogenic layer 203, to an amount or thickness of 1 g/m^2. The applied material is dried into the overcoat layer 201.

(5) Formation Of Adhesive Layer 205 And Removable Sheet 206

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

ADHESIVE	(unit: g)
1. Oil and fat	- 100
(Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	
2. Oil and fat	- 2
(Oil and fat B-45 from Ipposha Oil Industries Co. Ltd., Japan)	
3. Ethyl acetate	- 30

The above compounds are mixed and agitated to provide an adhesive, which is applied to the silicone-coated surface of the 60 μm thick removable sheet 206, to an amount or thickness of 20 g/m^2. The applied adhesive is dried into the adhesive layer 205 on the removable sheet 206.

(6) Production Of Printing Tape F

The removable sheet 206 is adhered via the adhesive layer 205 to the other major surface of the support layer 204 on the opposite side of the thermal chromogenic layer 203, barrier layer 202, and overcoat layer 201. Thus, the printing tape F is produced.

II. Production Of Printed Sample No.4

Hereinafter, by reference to Fig. 12, there will be described the manner of production of a printed sample No.4 by using the printing tape F. Fig. 12 is a plan view of a lower half housing 211 of a tape cartridge, Y, with an upper half housing (not shown) being removed. The printing tape F is accommodated in the cartridge Y in the same manner as the manner in which the printing tape E is accommodated in the cartridge X. The cartridge

Y has a construction similar to that of the cartridge X of Fig. 8, and the parts or portions of the cartridge Y which correspond to the counterparts of the cartridge X are denoted by respective reference numerals greater by a hundred than those of the counterparts. No further description of the cartridge Y is provided. The cartridge Y may be used with the tape-recording printer 120 of Fig. 9, which records, with the thermal head 115, images on a length of the printing tape F and thereby produces a printed sample No.4, in the same manner in which the printer 120 produces the printed sample No. 3 by using the printing tape E.

III. Production Of Comparative Printed Sample No.4

For carrying out comparison with the thus obtained printed sample No.4, a comparative printed sample No.4 is produced. The comparative printed sample No.4 is produced by using a comparative printing tape having basically the same structure as that of the printing tape F used for producing the invention printed sample No.4, but is different from the latter in that the former does not include an overcoat layer including an ultraviolet absorbing agent. However, the barrier layer of the comparative printing tape is formed with an amount or thickness of 2 g/m^2 that is twice as great as that of the barrier layer 202 of the printing tape F. The comparative printed sample No.4 is produced, like the invention printed sample No.4, by incorporating the comparative tape into a tape cartridge Y of Fig. 12, inserting the cartridge Y in the printer 120 of Fig. 9, and operating the thermal head 115 to effect desired printing on the comparative tape.

IV. Comparison Between Invention Printed Sample No.4 And Comparative Printed Sample No.4

The effect of the ultraviolet absorbing agent contained in the overcoat layer 201 of the invention sample No.4 is evaluated in comparison with the comparative sample No.4 wherein no such agent is contained in any layer thereof. The comparison test is carried out in the same manner as that described for the comparison test in Example 2. The test results are shown in the graph of Fig. 13.

The graph of Fig. 13 shows that the optical densities of the printed portion of the invention sample No.3 are changed from 1.29 to 1.13 during the 72 hour UV exposure and therefore the density change is only 0.16 whereas the optical densities of the printed portion of the comparative sample No.3 are changed from 1.26 to 0.88 under the same conditions and the density change is 0.38 much greater than 0.16. It is speculated that since the comparative sample No.4 does not include an overcoat layer containing an ultraviolet absorbing agent, the color images produced on the chromogenic layer thereof have discolored due to the exposure to the ultraviolet rays. Although discoloration occurs to some degree regarding the images recorded on the invention sample No.4, that degree is much lower than that of the comparative sample No.4 because the invention sample No.3 includes the overcoat layer 201 containing the ultraviolet absorbing agent.

The graph of Fig. 13 also shows the comparison between the optical densities of the non-printed portions of the invention and comparative samples No.4. Specifically, the optical densities of the non-printed portion of the invention sample No.4 are changed from 0.13 to 0.20 during the 72 hour UV exposure and thus the density change is only 0.07 whereas the optical densities of the non-printed portion of the comparative sample No.4 are changed from 0.11 to 0.36 under the same conditions and the density change is 0.25 much greater than 0.07. It is estimated that since the comparative sample No.4 does not include an overcoat layer containing an ultraviolet absorber, the non-printed portion of the comparative printing tape has become yellowish due to the exposure to the ultraviolet rays. Although yellowing occurs to some degree regarding the non-printed portion of the printing tape F as the invention sample No.4, that degree is much lower than that of the comparative sample No.4 because the invention sample No.4 includes the overcoat layer 201 containing the ultraviolet absorbing agent.

Thus, the ultraviolet absorbing agent contained in the overcoat layer 201 of the printing tape F as the invention sample No.4 effectively protects, against ultraviolet rays, not only the printed (colored) portion but also the non-printed portion of the chromogenic layer 203 of the printing tape F.

As is apparent from the foregoing description, the printing tapes F in accordance with the present invention includes, on the barrier layer 202 provided on the chromogenic layer 203, the overcoat layer 201 containing an ultraviolet absorbing agent, and therefore not only the printed portion but also the non-printed portion of the printing tape F are effectively protected against ultraviolet rays. Thus, discoloration of the printed portion is minimized, and discoloration or yellowing of the non-printed portion is prevented. The printing tape E can be used for a long time with stability, e.g., without deterioration of the images recorded thereon.

Meanwhile, the tape cartridge Y of Fig. 12 accommodates the printing tape F which includes, on one surface of the chromogenic layer 203, the barrier layer 202 and overcoat layer 201 formed in this order and, on the opposite surface of the support layer 204, the removable sheet 206 adhered thereto via the adhesive layer 205. Thus, the tape cartridge Y does not need any printer ribbon or any parts for feeding the ribbon therein.

Therefore, the overall construction of the cartridge Y is simplified. Additionally, the feeding of the printing tape F is effected with stability or smoothness, without being interfered with by the feeding of the ribbon. Furthermore, the number of the parts necessary for constituting the cartridge Y is reduced, and therefore the cartridge Y is produced at reduced cost. Furthermore, since the overcoat layer 101 is provided over the barrier layer 202 which is provided over the thermal chromogenic layer 102 in which images such characters are recorded, the images recorded in the printing tape F enjoy extremely enhanced abrasion resistance. That is, the printing tape F is very fast and secure.

Referring next to Fig. 14, there is shown a fifth embodiment, G, of a printing tape in accordance with the present invention.

The printing tape G includes a heat-sensitive or thermal chromogenic layer 303, an overcoat layer 301 for protecting the thermal chromogenic layer 303, an ultraviolet absorbing layer 302 containing an ultraviolet absorbing agent, a support layer 304, an adhesive layer 305, and a removable sheet 306. The thermal chromogenic layer 303, support layer 304, adhesive layer 305, and removable sheet 306 are the same as the counterparts 102, 103, 104, 105 of the printing tape E of Fig. 7, and no further description thereof is provided.

The ultraviolet absorbing layer 302 is preferably formed of polyvinyl alchol, methyl cellulose, ethyl cellulose, carboxymethyl cellulose, polyvinyl pyrrolidone, polyacrylamide, starch, gelatin, or methoxy cellulose. In the fifth embodiment, the ultraviolet absorbing layer 302 contains an ultraviolet absorbing agent which is preferably selected from the previously-described derivatives of benzotriazole used for being dispersed in the first support layer 1 of the printing tape A or B of Fig. 1 or Fig. 2.

The overcoat layer 301 is preferably formed of one of the previously-described materials used for forming the overcoat layer P of the printing tape B. For protecting the chromogenic layer 303 against water or moisture, the overcoat layer 301 contains an anti-water agent which is preferably selected from the previously-described substances used for the overcoat layer P of the printing tape B.

The removable sheet 306 is provided over one of opposite major surfaces of the support layer 304 via the adhesive layer 305 provided therebetween, and the thermal chromogenic layer 303 is provided by coating over the other major surface of the support layer 304. Additionally, the ultraviolet absorbing layer 302 and the overcoat layer 301 are provided over the thermal chromogenic layer 303 in the order of description.

Example 4

I. Production Of Printing Tape G

An example of the printing tape G constructed as described above is produced as follows:

(1) Formation Of Support Layer 304

A 38 μm thick polyester film (S-38 available from Teijin Ltd., Japan) is used as the the support layer 304.

(2) Preparation Of Material For Chromogenic Layer 303

For preparing the coating material for forming the thermal chromogenic layer 303, first, a liquid, A, and a liquid, B, are prepared which have the following compositions, respectively:

(unit: g)

LIQUID A	
1. Leuco-dye	
3-diethylamino-6-methyl-7-anilinofluoran	- 5
2. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
3. Water	- 100
LIQUID B	
1. Color developer	
bisphenol A	- 10
2. Reaction promoter	
stearic acid amide	- 7
3. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
4. Water	- 100

After the liquids A and B are prepared, each of the two liquids is brought into dispersion by using a ball mill, separately from each other. Subsequently, 100 g of each of the liquids A and B, 50 g of epoxy-modified polyvinyl alcohol, and 50 g of water are mixed and agitated to provide the coating material for forming the thermal chromogenic layer 303.

(3) Application Of The Coating Material

The thus obtained coating material is applied to one of opposite major surfaces of the support layer 304, to an amount or thickness of 10 g/m^2. The applied material is dried into the chromogenic layer 303.

(4) Formation Of Ultraviolet Absorbing Layer 302

The following composition is prepared as the material for forming the ultraviolet absorbing layer 302:

	(unit: g)
1. 20% solution of epoxy-modified polyvinyl alcohol	- 40
2. Ultraviolet absorbing agent 2-(3-tert-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole	- 2
3. Water	- 100

The thus obtained material is applied by gravure coating onto the exposed surface of the thermal chromogenic layer 303 formed on the support layer 304, to an amount or thickness of 1 g/m^2. The applied material is dried into the ultraviolet absorbing layer 302.

(5) Formation Of Overcoat Layer 301

The following composition is prepared as the material for forming the overcoat layer 301:

	(unit: g)
1. 20% solution of epoxy-modified polyvinyl alcohol	- 40
2. Water	- 100

The thus obtained material is applied by gravure coating onto the exposed surface of the ultraviolet absorbing layer 302 formed on the thermal chromogenic layer 303, to an amount or thickness of 1 g/m^2. The applied material is dried into the overcoat layer 301.

(5) Formation Of Adhesive Layer 305 And Removable Sheet 306

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

ADHESIVE	(unit: g)
1. Oil and fat (Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	- 100
2. Oil and fat (Oil and fat B-45 from Ipposha Oil Industries Co. Ltd., Japan)	- 2
3. Ethyl acetate	- 30

The above compounds are mixed and agitated to provide an adhesive, which is applied to the silicone-coated surface of the 60 μm thick removable sheet 306, to an amount or thickness of 20 g/m^2. The applied

adhesive is dried into the adhesive layer 305 on the removable sheet 306.

(6) Production Of Printing Tape G

The removable sheet 306 is adhered via the adhesive layer 305 to the other major surface of the support layer 304 on the opposite side of the thermal chromogenic layer 303, ultraviolet absorbing layer 302, and overcoat layer 301. Thus, the printing tape G is produced.

II. Production Of Printed Sample No.5

Hereinafter, by reference to Fig. 15, there will be described the manner of production of a printed sample No.5 by using the printing tape G. Fig. 15 is a plan view of a lower half housing 311 of a tape cartridge, Z, with an upper half housing (not shown) being removed. The printing tape G is accommodated in the cartridge Z in the same manner as the manner in which the printing tape E is accommodated in the cartridge X of Fig. 8. The cartridge Z has a construction similar to that of the cartridge X, and the parts or portions of the cartridge Z which correspond to the counterparts of the cartridge X are denoted by respective reference numerals greater by two hundreds than those of the counterparts of the cartridge X. No further description of the cartridge Z is provided. The cartridge Z may be used with the tape-recording printer 120 of Fig. 9 which records, with the thermal head 115, images on a length of the printing tape G and thereby produces a printed sample No.5, in the same manner in which the printer 120 produces the printed sample No. 3 by using the printing tape E.

III. Production Of Comparative Printed Sample No.5

For carrying out comparison with the thus obtained printed sample No.5, a comparative printed-sample No.5 is produced. The comparative printed sample No.5 is obtained by using a comparative printing tape having basically the same structure as that of the printing tape G used for producing the invention printed sample No.5, but is different from the latter in that the former does not include an ultraviolet absorbing layer 301 containing an ultraviolet absorbing agent. However, the overcoat layer of the comparative printing tape is formed with an amount or thickness of 2 g/m^2 that is twice as great as that of the overcoat layer 301 of the printing tape G. The comparative printed sample No.5 is produced, like the invention printed sample No.5, by incorporating the comparative tape into a tape cartridge Z shown in Fig. 15, inserting the cartridge Z in the printer 120 of Fig. 9, and operating the thermal head 115 to effect desired printing on the comparative tape.

IV. Comparison Between Invention Printed Sample No.5 And Comparative Printed Sample No.5

The effect of the ultraviolet absorbing agent contained in the ultraviolet absorbing layer 302 of the invention sample No.5 is evaluated in comparison with the comparative sample No.5 which does not include an ultraviolet absorbing layer. The comparison test is carried out in the same manner as that described for the comparison test in Example 2. The test results are shown in the graph of Fig. 16.

The graph of Fig. 16 shows that the optical densities of the printed portion of the invention sample No.5 are changed from 1.20 to 1.03 during the 72 hour UV exposure and therefore the density change is only 0.17 whereas the optical densities of the printed portion of the comparative sample No.5 are changed from 1.20 to 0.84 under the same conditions and the density change is 0.36 much greater than 0.17. It is speculated that since the comparative sample No.5 does not include an ultraviolet absorbing layer, the color images produced on the chromogenic layer thereof have discolored due to the exposure to the ultraviolet rays. Although discoloration occurs to some degree regarding the images recorded on the invention sample No.5, that degree is much lower than that of the comparative sample No.5 because the invention sample No.5 includes the ultraviolet absorbing layer 302.

The graph of Fig. 16 also shows the comparison between the optical densities of the non-printed portions of the invention and comparative samples No.5. Specifically, the optical densities of the non-printed portion of the invention sample No.5 are changed from 0.10 to 0.19 during the 72 hour UV exposure and thus the density change is only 0.09 whereas the optical densities of the non-printed portion of the comparative sample No.5 are changed from 0.10 to 0.37 under the same conditions and the density change is 0.27 much greater than 0.09. It is estimated that since the comparative sample No.5 does not include an ultraviolet absorbing layer, the non-printed portion of the comparative printing tape has become yellowish due to the exposure to the ultraviolet rays. Although yellowing occurs to some degree regarding the non-printed portion of the printing tape F as the invention sample No.5, that degree is much lower than that of the comparative sample No.5 because the invention sample No.4 includes the ultraviolet absorbing layer 302.

Thus, the ultraviolet absorbing layer 302 of the printing tape G as the invention sample No.5 effectively protects, against ultraviolet rays, not only the printed (colored) portion but also the non-printed portion of the chromogenic layer 303 of the printing tape G.

As is apparent from the foregoing description, the printing tape G in accordance with the present invention includes the ultraviolet absorbing layer 302 provided over the chromogenic layer 303, therefore not only the printed portion but also the non-printed portion of the printing tape G are effectively protected against ultraviolet rays. Thus, discoloration of the printed portion is minimized, and discoloration or yellowing of the non-printed portion is prevented. The printing tape G can be used for a long time with stability, e.g., without deterioration of the images recorded thereon.

Meanwhile, the tape cartridge Z of Fig. 15 accommodates the printing tape G which includes, on one surface of the supper layer 304, the chromogenic layer 303, ultraviolet absorbing layer 302, and overcoat layer 301 provided in the order of description and, on the opposite surface of the support layer 304, the removable sheet 306 adhered thereto via the adhesive layer 305. Thus, the tape cartridge Z does not need any printer ribbon or any parts for feeding the ribbon therein. Therefore, the overall construction of the cartridge Z is simplified. Additionally, the feeding of the printing tape G is effected with stability or smoothness, without being interfered with by the feeding of the ribbon. Furthermore, the number of the parts necessary for constituting the cartridge Z is reduced, and therefore the cartridge Z is produced at reduced cost. Furthermore, since the overcoat layer 301 is provided over the ultraviolet absorbing layer 302 provided over the thermal chromogenic layer 303 in which images such characters are recorded, the images recorded in the printing tape G enjoy extremely enhanced abrasion resistance. That is, the printing tape G is very fast and secure.

Referring next to Fig. 17, there is shown a sixth embodiment, H, of a printing tape in accordance with the present invention.

The printing tape H includes a heat-sensitive or thermal chromogenic layer 402, an overcoat layer 401 containing an ultraviolet absorbing agent and serving for protecting the thermal chromogenic layer 402, a support layer 403, an adhesive layer 404, and a removable sheet 405. The support layer 403, adhesive layer 404, and removable sheet 405 are the same as the counterparts 103, 104, 105 of the printing tape E of Fig. 7, and no further description thereof is provided.

The thermal chromogenic layer 402 is formed of the same composition as that used for forming the thermal chromogenic layer 102 of the printing tape E. In the sixth embodiment, the chromogenic layer 402 further contains a photostabilizing agent which is preferably selected from the previously-described hindered amine compounds used for being dispersed in the first support layer 1 of the printing tape A or B of Fig. 1 or 2.

The overcoat layer 401 is preferably formed of one of the previously-described materials used for forming the overcoat layer P of the printing tape B. The overcoat 401 contains an ultraviolet absorbing agent which is preferably selected from the previously-described derivatives of benzotriazole used for being dispersed in the first support layer 1 of the printing tape A or B. For protecting the chromogenic layer 402 against water or moisture, the overcoat layer 401 further contains an anti-water agent which is preferably selected from the previously-described substances used for the overcoat layer P of the printing tape B.

The removable sheet 405 is provided over one of opposite major surfaces of the support layer 403 via the adhesive layer 404 provided therebetween, and the thermal chromogenic layer 402 is provided by coating over the other major surface of the support layer 403. Additionally, the overcoat layer 401 is provided over the thermal chromogenic layer 402. An ultraviolet absorbing agent is contained or dispersed in the overcoat layer 401.

Example 5

I. Production Of Printing Tape H

An example of the printing tape H constructed as described above is produced as follows:

(1) Formation Of Support Layer 403

A 38 μm thick polyester film (S-38 available from Teijin Ltd., Japan) is used as the the support layer 403.

(2) Preparation Of Material For Chromogenic Layer 402

For preparing the coating material for forming the thermal chromogenic layer 402, first, a liquid, A, and a liquid, B, are prepared which have the following compositions, respectively:

(unit: g)

LIQUID A	
1. Leuco-dye	
3-diethylamino-6-methyl-7-anilinofluoran	- 5
2. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
3. Photostabilizing agent	
bis(1,2,2,6,6-pentamethyl-4-piperidyl) 2-(3,5-di-t-butyl-4-hydroxybenzyl)-2-n-butylmalonate	- 2
4. Water	- 100
LIQUID B	
1. Color developer	
bisphenol A	- 10
2. Reaction promoter	
stearic acid amide	- 7
3. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
4. Water	- 100

After the liquids A and B are prepared, each of the two liquids is brought into dispersion by using a ball mill, separately from each other. Subsequently, 100 g of each of the liquids A and B, 50 g of epoxy-modified polyvinyl alcohol, and 50 g of water are mixed and agitated to provide the coating material for forming the thermal chromogenic layer 402.

(3) Application Of The Coating Material

The thus obtained coating material is applied to one of the opposite major surfaces of the support layer 403, to an amount or thickness of 10 g/m^2. The applied material is dried into the chromogenic layer 402.

(4) Formation Of Overcoat Layer 401

The following composition is prepared as the material for forming the overcoat layer 401:

	(unit: g)
1. 20% solution of epoxy-modified polyvinyl alcohol	- 40
2. Ultraviolet absorbing agent	
2-(3-tert-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole	- 2
3. Water	- 100

The thus obtained material is applied by gravure coating onto the exposed surface of the thermal chromogenic layer 402, to an amount or thickness of 1 g/m^2. The applied material is dried into the overcoat layer 401.

(5) Formation Of Adhesive Layer 404 And Removable Sheet 405

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

ADHESIVE	(unit: g)
1. Oil and fat (Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	- 100
2. Oil and fat (Oil and fat B-45 from Ipposha Oil Industries Co. Ltd., Japan)	- 2
3. Ethyl acetate	- 30

The above compounds are mixed and agitated to provide an adhesive, which is applied to the silicone-coated surface of the 60 μm thick removable sheet 405, to an amount or thickness of 20 g/m^2. The applied adhesive is dried into the adhesive layer 404 on the removable sheet 405.

(6) Production Of Printing Tape H

The removable sheet 405 is adhered via the adhesive layer 404 to the other major surface of the support layer 403 on the opposite side of the thermal chromogenic layer 402 and overcoat layer 401. Thus, the printing tape H is produced.

II. Production Of Printed Sample No.6

Hereinafter, by reference to Fig. 18, there will be described the manner of production of a printed sample No.6 by using the printing tape H. Fig. 18 is a plan view of a lower half housing 411 of a tape cartridge, Q, with an upper half housing (not shown) being removed. The printing tape H is accommodated in the cartridge Q in the same manner as the manner in which the printing tape E is accommodated in the cartridge X of Fig. 8. The cartridge Q has a construction similar to that of the cartridge X, and the parts or portions of the cartridge Q which correspond to the counterparts of the cartridge X are denoted by respective reference numerals greater by three hundreds than those of the counterparts of the cartridge X. No further description of the cartridge Q is provided. The cartridge Q may be used with the tape-recording printer 120 of Fig. 9 which records, with the thermal head 115, images on a length of the printing tape H and thereby produces a printed sample No.6, in the same manner in which the printer 120 produces the printed sample No. 3 by using the printing tape E.

III. Production Of Comparative Printed Sample No.6

For carrying out comparison with the thus obtained printed sample No.6, a comparative printed sample No.6 is produced. The comparative printed sample No.6 is obtained by using a comparative printing tape having basically the same structure as that of the printing tape H used for producing the invention printed sample No.6, but is different from the latter in that the former does not contain a photostabilizing agent in the thermal chromogenic layer thereof or an ultraviolet absorbing agent in the overcoat layer thereof. The comparative printed sample No.6 is produced, like the invention printed sample No.6, by incorporating the comparative tape into a tape cartridge Q shown in Fig. 18, inserting the cartridge Q in the printer 120 of Fig. 9, and operating the thermal head 115 to effect desired printing on the comparative tape.

IV. Comparison Between Invention Printed Sample No.6 And Comparative Printed Sample No.6

The effects of the photostabilizing agent contained in the thermal chromogenic layer 402 and the ultraviolet absorbing agent contained in the overcoat layer 401 of the invention sample No.6 are evaluated in comparison with the comparative sample No.6 wherein no such agent is contained in the chromogenic or overcoat layer thereof. The comparison test is carried out in the same manner as that described for the comparison test in Example 2. The test results are shown in the graph of Fig. 19.

The graph of Fig. 19 shows that the optical densities of the printed portion of the invention sample No.6 are changed from 1.23 to 1.01 during the 72 hour UV exposure and therefore the density change is only 0.22 whereas the optical densities of the printed portion of the comparative sample No.6 are changed from 1.23 to 0.86 under the same conditions and the density change is 0.37 much greater than 0.22. It is speculated that since the comparative sample No.6 does not contain a photostabilizing agent in the thermal chromogenic layer thereof or an ultraviolet absorbing agent in the overcoat layer thereof, the color images produced on the chromogenic layer thereof have discolored due to the exposure to the ultraviolet rays. Although discoloration occurs to some degree regarding the images recorded on the invention sample No.6, that degree is much lower than that of the comparative sample No.6 because the invention sample No.6 contains the photostabilizing agent in the thermal chromogenic layer 402 and the ultraviolet absorbing agent in the overcoat layer 401.

The graph of Fig. 19 also shows the comparison between the optical densities of the non-printed portions of the invention and comparative samples No.6. Specifically, the optical densities of the non-printed portion of the invention sample No.6 are changed from 0.08 to 0.18 during the 72 hour UV exposure and thus the density change is only 0.10 whereas the optical densities of the non-printed portion of the comparative sample No.6 are changed from 0.08 to 0.30 under the same conditions and the density change is 0.22 much greater than 0.10. It is estimated that since the comparative sample No.6 does not contain a photostabilizing agent in the thermal chromogenic layer thereof or an ultraviolet absorbing agent in the overcoat layer thereof, the non-printed portion of the comparative printing tape has become yellowish due to the exposure to the ultraviolet rays. Although yellowing occurs to some degree regarding the non-printed portion of the printing tape H as the invention sample No.6, that degree is much lower than that of the comparative sample No.6 because the invention sample No.6 contains the photostabilizing agent in the thermal chromogenic layer 402 and the ultraviolet absorbing agent in the overcoat layer 401.

Thus, the ultraviolet absorbing agent contained or dispersed in the overcoat layer 401 of the printing tape H as the invention sample No.6 effectively protects, against ultraviolet rays, not only the printed (colored) portion but also the non-printed portion of the chromogenic layer 402 of the printing tape H.

As is apparent from the foregoing description, the printing tape H in accordance with the present invention contains the photostabilizing agent in the thermal chromogenic layer 402 provided over one surface of the support layer 403 and contains the ultraviolet absorbing agent in the overcoat layer 401 provided over the chromogenic layer 402, therefore not only the printed portion but also the non-printed portion of the printing tape H are effectively protected against ultraviolet rays. Thus, discoloration of the printed portion is minimized, and discoloration or yellowing of the non-printed portion is prevented. The printing tape H can be used for a long time with stability, e.g., without deterioration of the images recorded thereon.

Meanwhile, the tape cartridge Q of Fig. 18 accommodates the printing tape H which includes, on one surface of the supper layer 403, the chromogenic layer 402 and the overcoat layer 401 provided in the order of description and, on the opposite surface of the support layer 403, the removable sheet 405 adhered thereto via the adhesive layer 404. Thus, the tape cartridge Q does not need any printer ribbon or any part for feeding the ribbon therein. Therefore, the overall construction of the cartridge Q is simplified. Additionally, the feeding of the printing tape H is effected with stability or smoothness, without being interfered with by the feeding of the ribbon. Furthermore, the number of the parts necessary for constituting the cartridge Q is reduced, and therefore the cartridge Q is produced at reduced cost. Furthermore, since the overcoat layer 401 is provided

over the thermal chromogenic layer 402 in which images such characters are recorded, the images recorded in the printing tape H enjoy extremely improved abrasion resistance. That is, the printing tape H is very fast and secure.

Referring next to Fig. 20, there is shown a seventh embodiment, J, of a printing tape in accordance with the present invention.

The printing tape J includes a heat-sensitive or thermal chromogenic layer 502, an overcoat layer 501 for protecting the thermal chromogenic layer 502, a support layer 503, an adhesive layer 504, and a removable sheet 505. The support layer 503, adhesive layer 504, and removable sheet 505 are the same as the counterparts 103, 104, 105 of the printing tape E of Fig. 7, and no further description thereof is provided.

The thermal chromogenic layer 502 is preferably formed of the same composition as that used for forming the thermal chromogenic layer 102 of the printing tape E. In the sixth embodiment, the chromogenic layer 502 further contains an ultraviolet absorbing agent which is preferably selected from the previously-described derivatives of benzotriazole used for being dispersed in the first support layer 1 of the printing tape A or B of Fig. 1 or 2. The chromogenic layer 502 may additionally contain a photostabilizing agent which is preferably selected from the previously-described hindered amine compounds used for being dispersed in the first support layer 1 of the printing tape A or B.

The overcoat layer 501 is preferably formed of one of the previously-described materials used for forming the overcoat layer P of the printing tape B. For protecting the chromogenic layer 502 against water or moisture, the overcoat layer 501 contains an anti-water agent which is preferably selected from the previously-described substances used for the overcoat layer P of the printing tape B.

The removable sheet 505 is provided over one of opposite major surfaces of the support layer 503 via the adhesive layer 504 provided therebetween, and the thermal chromogenic layer 502 is provided by coating over the other major surface of the support layer 503. Additionally, the overcoat layer 501 is provided over the thermal chromogenic layer 502. An ultraviolet absorbing agent is contained or dispersed in the chromogenic layer 502.

Example 6

I. Production Of Printing Tape J

An example of the printing tape J constructed as described above is produced as follows:

(1) Formation Of Support Layer 503

A 38 μm thick polyester film (S-38 available from Teijin Ltd., Japan) is used as the the support layer 503.

(2) Preparation Of Material For Chromogenic Layer 502

For preparing the coating material for forming the thermal chromogenic layer 502, first, a liquid, A, and a liquid, B, are prepared which have the following compositions, respectively:

	(unit: g)
LIQUID A	
1. Leuco-dye	
3-diethylamino-6-methyl-7-anilinofluoran	- 5
2. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
3. Water	- 100
4. Ultraviolet absorbing agent	
2-(3,5-di-tert-butyl-2-hydroxyphenyl)-benzotriazole	- 2
LIQUID B	
1. Color developer	
bisphenol A	- 10
2. Reaction promoter	
stearic acid amide	- 7
3. Binder	
20% solution of epoxy-modified polyvinyl alcohol	- 40
4. Water	- 100

After the liquids A and B are prepared, each of the two liquids is brought into dispersion by using a ball mill, separately from each other. Subsequently, 100 g of each of the liquids A and B, 50 g of epoxy-modified polyvinyl alcohol, and 50 g of water are mixed and agitated to provide the coating material for forming the thermal chromogenic layer 502.

(3) Application Of The Coating Material

The thus obtained coating material is applied to one of the opposite major surfaces of the support layer 503, to an amount or thickness of 10 g/m^2. The applied material is dried into the chromogenic layer 502.

(4) Formation Of Overcoat Layer 501

The following composition is prepared as the material for forming the overcoat layer 501:

	(unit: g)
1. 20% solution of epoxy-modified polyvinyl alcohol	- 40
2. Water	- 100

The thus obtained material is applied by gravure coating onto the exposed surface of the thermal chromogenic layer 502, to an amount or thickness of 1 g/m^2. The applied material is dried into the overcoat layer 501.

(5) Formation Of Adhesive Layer 504 And Removable Sheet 505

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

ADHESIVE	(unit: g)
1. Oil and fat (Oil and fat AS-2050 from Ipposha Oil Industries Co. Ltd., Japan)	- 100 -
2. Oil and fat (Oil and fat B-45 from Ipposha Oil Industries Co. Ltd., Japan)	- 2
3. Ethyl acetate	- 30

The above compounds are mixed and agitated to provide an adhesive, which is applied to the silicone-coated surface of the 60 μm thick removable sheet 505, to an amount or thickness of 20 g/m^2. The applied adhesive is dried into the adhesive layer 504 on the removable sheet 505.

(6) Production Of Printing Tape J

The removable sheet 505 is adhered via the adhesive layer 504 to the other major surface of the support layer 503 on the opposite side of the thermal chromogenic layer 502 and overcoat layer 501. Thus, the printing tape J is produced.

II. Production Of Printed Sample No.7

Hereinafter, by reference to Fig. 21, there will be described the manner of production of a printed sample No.7 by using the printing tape J. Fig. 21 is a plan view of a lower half housing 511 of a tape cartridge, S, with an upper half housing (not shown) being removed. The printing tape J is accommodated in the cartridge S in the same manner as the manner in which the printing tape E is accommodated in the cartridge X of Fig. 8. The cartridge S has a construction similar to that of the cartridge X, and the parts or portions of the cartridge S which correspond to the counterparts of the cartridge X are denoted by respective reference numerals greater by four hundreds than those of the counterparts of the cartridge X. No further description of the cartridge S is provided. The cartridge S may be used with the tape-recording printer 120 of Fig. 9 which records, with the thermal head 115, images on a length of the printing tape J and thereby produces a printed sample No.7, in the same manner in which the printer 120 produces the printed sample No. 3 by using the printing tape E.

III. Production Of Comparative Printed Sample No.7

For carrying out comparison with the thus obtained printed sample No.7, a comparative printed sample No.7 is produced. The comparative printed sample No.7 is obtained by using a comparative printing tape having basically the same structure as that of the printing tape J used for producing the invention printed sample No.7, but is different from the latter in that the former does not contain an ultraviolet absorbing agent in the chromogenic layer thereof. The comparative printed sample No.7 is produced, like the invention printed sample No.7, by incorporating the comparative tape into a tape cartridge S shown in Fig. 21, inserting the cartridge S in the printer 120 of Fig. 9, and operating the thermal head 115 to effect desired printing on the comparative tape.

IV. Comparison Between Invention Printed Sample No.7 And Comparative Printed Sample No.7

The effect of the ultraviolet absorbing agent contained in the chromogenic layer 502 of the invention sample No.7 is evaluated in comparison with the comparative sample No.7 wherein no such agent is contained in the chromogenic layer. The comparison test is carried out in the same manner as that described for the com-

parison test in Example 2. The test results are shown in the graph of Fig. 22.

The graph of Fig. 22 shows that the optical densities of the printed portion of the invention sample No.7 are changed from 1.23 to 1.01 during the 72 hour UV exposure and therefore the density change is only 0.22 whereas the optical densities of the printed portion of the comparative sample No.7 are changed from 1.23 to 0.86 under the same conditions and the density change is 0.37 much greater than 0.22. It is speculated that since the comparative sample No.7 does not contain an ultraviolet absorbing agent in the chromogenic layer thereof, the color images produced on the chromogenic layer thereof have discolored due to the exposure to the ultraviolet rays. Although discoloration occurs to some degree regarding the images recorded on the invention sample No.7, that degree is much lower than that of the comparative sample No.7 because the invention sample No.7 contains the ultraviolet absorbing agent in the chromogenic layer 502.

The graph of Fig. 22 also shows the comparison between the optical densities of the non-printed portions of the invention and comparative samples No.7. Specifically, the optical densities of the non-printed portion of the invention sample No.7 are changed from 0.08 to 0.18 during the 72 hour UV exposure and thus the density change is only 0.10 whereas the optical densities of the non-printed portion of the comparative sample No.6 are changed from 0.08 to 0.30 under the same conditions and the density change is 0.22 much greater than 0.10. It is estimated that since the comparative sample No.7 does not contain an ultraviolet absorbing agent in the chromogenic layer thereof, the non-printed portion of the comparative printing tape has become yellowish due to the exposure to the ultraviolet rays. Although yellowing occurs to some degree regarding the non-printed portion of the printing tape J as the invention sample No.7, that degree is much lower than that of the comparative sample No.7 because the invention sample No.7 contains the ultraviolet absorbing agent in the chromogenic layer 502.

Thus, the ultraviolet absorbing agent contained or dispersed in the chromogenic layer 502 of the printing tape J as the invention sample No.7 effectively protects, against ultraviolet rays, not only the printed (colored) portion but also the non-printed portion of the chromogenic layer 502 of the printing tape J.

As is apparent from the foregoing description, the printing tape J in accordance with the present invention contains the ultraviolet absorbing agent in the chromogenic layer 502 provided over one surface of the support layer 503, therefore not only the printed portion but also the non-printed portion of the printing tape J are effectively protected against ultraviolet rays. Thus, discoloration of the printed portion is minimized, and discoloration or yellowing of the non-printed portion is prevented. The printing tape J can be used for a long time with stability, e.g., without deterioration of the images recorded thereon.

Meanwhile, the tape cartridge S of Fig. 21 accommodates the printing tape H which includes, on one surface of the supper layer 503, the chromogenic layer 502 and the overcoat layer 501 provided in the order of description and, on the opposite surface of the support layer 503, the removable sheet 505 adhered thereto via the adhesive layer 504. Thus, the tape cartridge S does not need any printer ribbon or any part for feeding the ribbon therein. Therefore, the overall construction of the cartridge S is simplified. Additionally, the feeding of the printing tape J is effected with stability or smoothness, without being interfered with by the feeding of the ribbon. Furthermore, the number of the parts necessary for constituting the cartridge S is reduced, and therefore the cartridge S is produced at reduced cost. Moreover, since the overcoat layer 501 is provided over the thermal chromogenic layer 502 in which images such characters are recorded, the images recorded in the printing tape J enjoy extremely improved abrasion resistance. That is, the printing tape J is very fast and secure.

It is to be understood that the present invention may be embodied with other changes, improvements or modifications that may occur to those skilled in the art without departing from the scope of the present invention defined in the appended claims.

Claims

1. A printing tape (A, B, E, F, G, H) for use with a tape-recording printer (20, 120) including a thermal head (15, 115) for thermally recording images, such as characters, on the printing tape, the tape comprising:

   a heat-sensitive layer (2, 102, 203, 303, 402) containing a heat-sensitive chromogenic material, said heat-sensitive layer being for the production of images when heated by the thermal head; and

   an ultraviolet absorbing layer (1, 101, 201, 302, 401) containing an ultraviolet absorbing agent, said ultraviolet absorbing layer being provided over the one of the opposite major surfaces of said heat-sensitive layer that will be exposed to ultraviolet radiation, in use.

2. A printing tape as claimed in claim 1, further comprising:

   a support layer (103, 204, 304, 403);

   an adhesive layer (104, 205, 305, 404) provided over one of opposite major surfaces of said support

layer; and

a removable sheet (105, 206, 306, 405) provided over said adhesive layer,

said heat-sensitive layer being provided over said support layer such that the other major surface of said heat-sensitive layer is opposite to the other major surface of said support layer,

said removable sheet being for removal when the printing tape is used, so that the printing tape may be adhered to an object via said adhesive layer and with said ultraviolet absorbing layer exposed to ultraviolet radiation.

3. A printing tape as claimed in claim 1 or 2, further comprising a barrier layer (202) interposed between said one major surface of said heat-sensitive layer (203) and said ultraviolet absorbing layer (201).

4. A printing tape as claimed in claim 1, further comprising:

a support layer (4);

a first adhesive layer (5) provided over one of opposite major surfaces of said support layer;

a second adhesive layer (3) provided over the other major surface of said support layer; and

a removable sheet (6) provided over said first adhesive layer,

said heat-sensitive layer (2) over which said ultraviolet absorbing layer (1) is provided being adhered via said second adhesive layer to said support layer such that the other major surface of said heat-sensitive layer is opposite to the other major surface of said support layer,

said removable sheet being for removal when the printing tape is used, so that the printing tape may be adhered to an object via said first adhesive layer and with said ultraviolet absorbing layer exposed to ultraviolet radiation.

5. A printing tape as claimed in claim 4, wherein said ultraviolet absorbing layer (1) contains a photostabilizing agent in addition to said ultraviolet absorbing agent.

6. A printing tape as claimed in claim 4 or claim 5, further comprising an overcoat layer (P) provided over the other major surface of said heat-sensitive layer (2), said heat-sensitive layer being arranged to be heated via said overcoat layer by the thermal head (15).

7. A printing tape (J) for use with a tape-recording printer (120) including a thermal head (115) for thermally recording images, such as characters, on the printing tape, the tape comprising:

a heat-sensitive layer (502) containing a heat-sensitive chromogenic material, said heat-sensitive layer being for the production of images when heated by the thermal head,

said heat-sensitive layer containing an ultraviolet absorbing agent in addition to said heat-sensitive chromogenic material.

8. A printing tape as claimed in claim 7, further comprising:

a support layer (503);

an adhesive layer (504) provided over one of opposite major surfaces of said support layer; and

a removable sheet (505) provided over said adhesive layer,

said heat-sensitive layer (502) being provided over the other major surface of said support layer,

said removable sheet being for removal when the printing tape is used, so that the printing tape may be adhered to an object via said adhesive layer and with said heat-sensitive layer exposed to ultraviolet radiation.

9. A printing tape as claimed in claim 7 or claim 8, further comprising an overcoat layer (501) provided over said heat-sensitive layer (502).

10. A printing tape as claimed in any of claims 1 to 6, further comprising an overcoat layer (301) provided over said ultraviolet absorbing layer (302).

11. A printing tape as claimed in any of the preceding claims, wherein said ultraviolet absorbing agent is selected from the group consisting of 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-2-hydroxyphenyl)benzotriazole,

2-(3-t-butyl-5-methyl-hydroxyphenyl)-5-chlorobenzotriazole,

2-(3,5-di-t-butyl-2-hydroxyphenyl)-5-chlorobenzotriazole,

or 2-(3,5-di-t-amyl-2-hydroxyphenyl)benzotriazole.

12. A printing tape as claimed in any of the preceding claims, wherein said heat-sensitive layer (402, 502) additionally contains a photostabilizing agent.

13. A printing tape as claimed in claim 12, wherein said photostabilizing agent is selected from the group consisting of hindered amine compounds such as
bis(2,2,6,6-tetramethyl-4-piperidyl) sebacate,
bis(1,2,2,6,6-pentamethyl-4-piperidyl) sebacate,
1-[2-[3-(3,5-di-t-butyl-4-hydroxyphenyl)propionyloxy]ethyl]-4-[3-(3,5-di-t-butyl-4-hydroxyphenyl)propionyloxy]-2,2,6,6-tetramethylpiperidine,
8-benzyl-7,7,9,9-tetramethyl-3-octyl-1,3,8-triazaspiro[4.5]-decane-2,4-dione,
4-benzoyloxy-2,2,6,6-tetramethylpiperidine,
condensation polymerization product of dimethyl succinate and 1-(2-hydroxyethyl)-4-hydroxy-2,2,6,6-tetramethylpiperidine,
poly[[6-(1,1,3,3-tetramethylbutyl)imino-1,3,5-triazine-2,4-diyl][(2,2,6,6-tetramethyl-4-piperidyl)imino]hexamethylene-[(2,2,6,6-tetramethyl-4-piperidyl)imino]], or
bis(1,2,2,6,6-pentamethyl-4-piperidyl) 2-(3,5-di-t-butyl-4-hydroxybenzyl)-2-n-butylmalonate.

14. A printing-tape cartridge (C, S, X, Y, Z, Q) accommodating a printing tape (A, B, E, F, G, H, J) as claimed in any of the preceding claims.

15. A printing-tape cartridge (X, Y, Z, Q) as claimed in claim 14, further comprising:
a housing (111, 211, 311, 411); and
a tape spool (110, 210, 310, 410) rotatably disposed inside said housing, said printing tape (E, F, G, H) being as claimed in any of claims 1 to 3 or any of claims 10 to 13 when dependent on any of claims 1 to 3 and being wound around said tape spool.

16. A printing-tape cartridge (C) accommodating a printing tape (A, B) for use with a tape-recording printer (20) including a thermal head (15) which thermally records images, such as characters, on the printing tape, the cartridge comprising:
a housing (11);
a first and a second tape spool (23, 10) rotatably disposed inside said housing;
a first tape (U) wound around said first tape spool, said first tape comprising
a support layer (4),
a first adhesive layer (5) provided over one of opposite major surfaces of said support layer,
a second adhesive layer (3) provided over the other major surface of said support layer, and
a removable sheet (6) provided over said first adhesive layer; and
a second tape (T, V) wound around said second tape spool, said second tape comprising
a heat-sensitive layer (2) containing a heat-sensitive chromogenic material, said heat-sensitive layer producing said images when being heated by said thermal head, and
an ultraviolet absorbing layer (1) containing an ultraviolet absorbing agent, said ultraviolet absorbing layer being provided over one of opposite surfaces of said heat-sensitive layer,
said second tape being adhered via said second adhesive layer to said first tape such that the other major surface of said heat-sensitive layer is opposite to the other major surface of said support layer, the adhered first and second tapes providing the printing tape,
said removable sheet being for removal when the printing tape is used, so that the printing tape may be adhered to an object via said first adhesive layer and with said ultraviolet absorbing layer exposed to ultraviolet radiation.

17. A printing-tape cartridge as claimed in claim 16, wherein said ultraviolet absorbing layer (1) contains a photostabilizing agent in addition to said ultraviolet absorbing agent.

18. A printing-tape cartridge as claimed in claim 16 or claim 17, wherein said second tape (V) further comprises an overcoat layer (P) provided over the other major surface of said heat-sensitive layer (2), said heat-sensitive layer being heatable, via said overcoat layer, by the thermal head (15).

19. A printing-tape cartridge (S) as claimed in claim 14, further comprising:
a housing (511); and

a tape spool (510) rotatably disposed inside said housing, said printing tape (J) being as claimed in any of claims 7 to 9, or any of claims 11 to 13 when dependent on any of claims 7 to 9, and being wound around said tape spool.

20. A printing-tape cartridge as claimed in claim 19, wherein said printing tape (J) further comprises an overcoat layer (501) provided over said heat-sensitive layer (502).

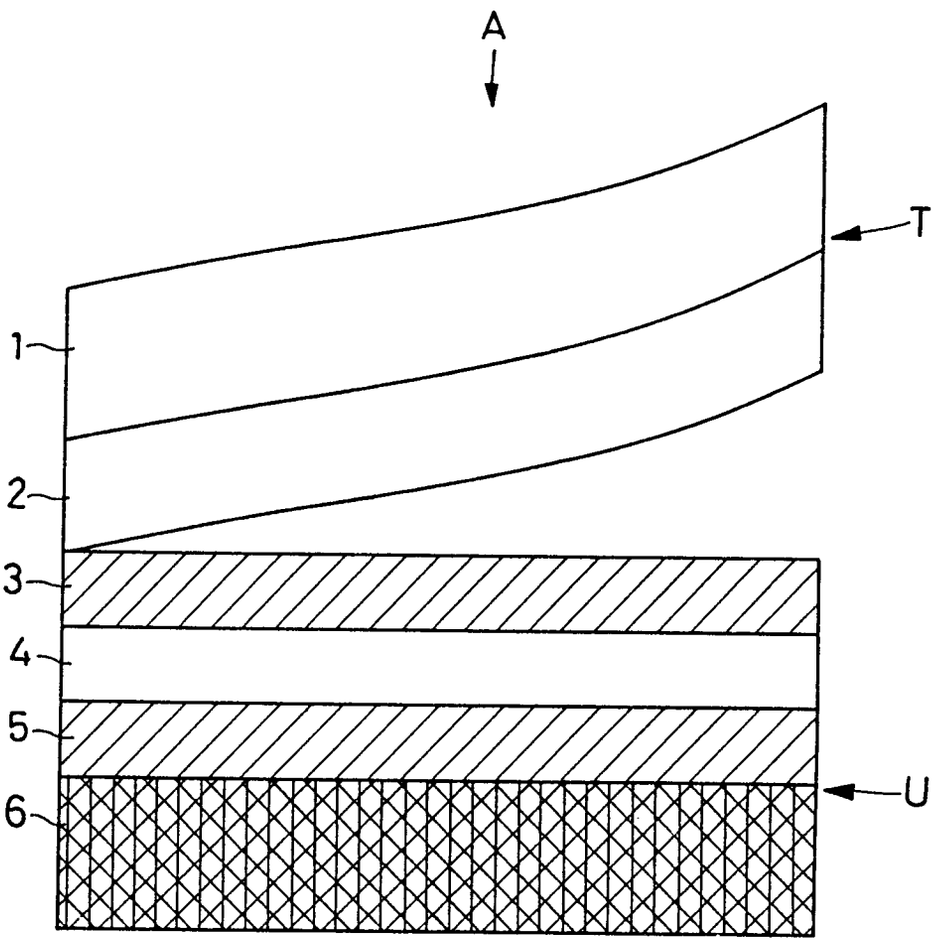


FIG. 1

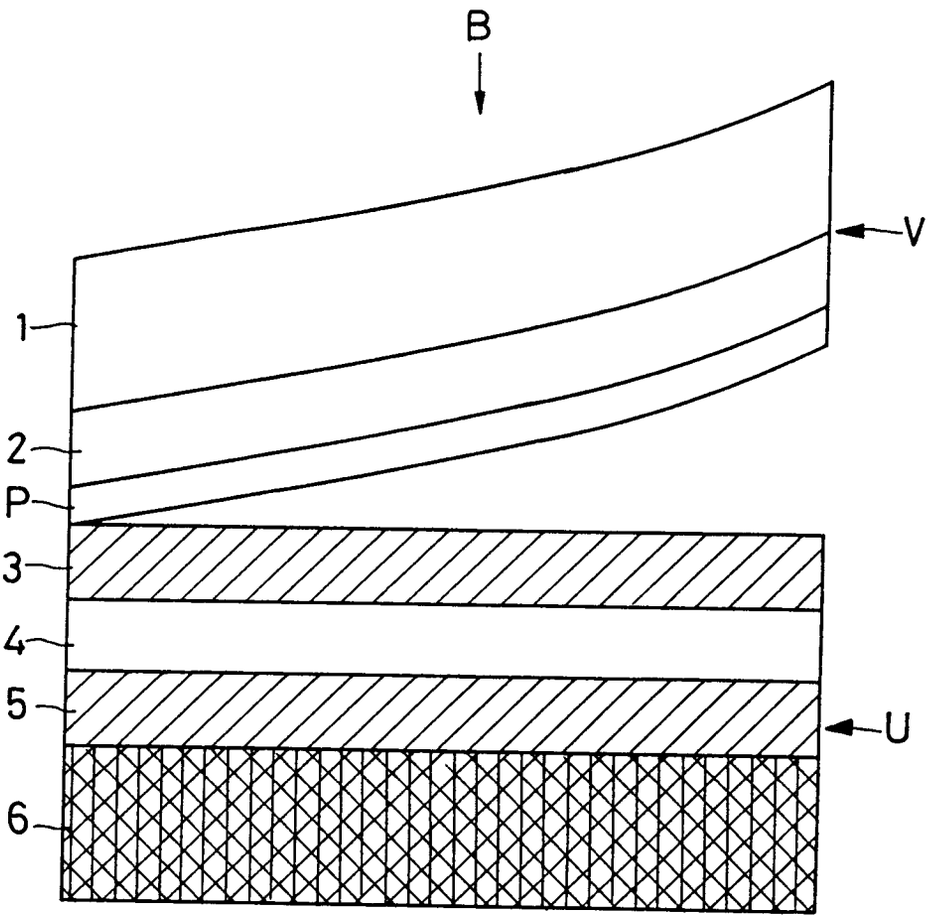


FIG. 2

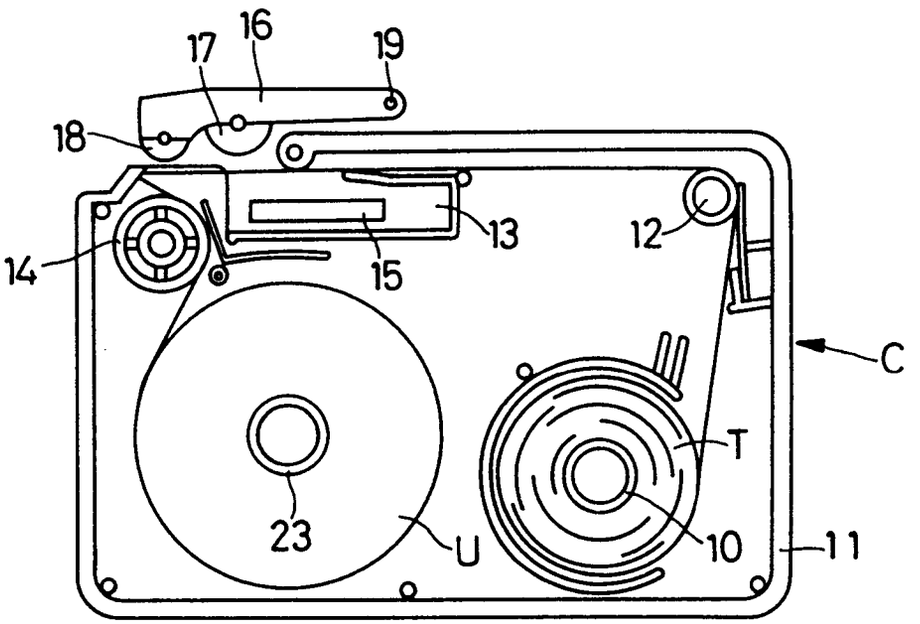


FIG.3

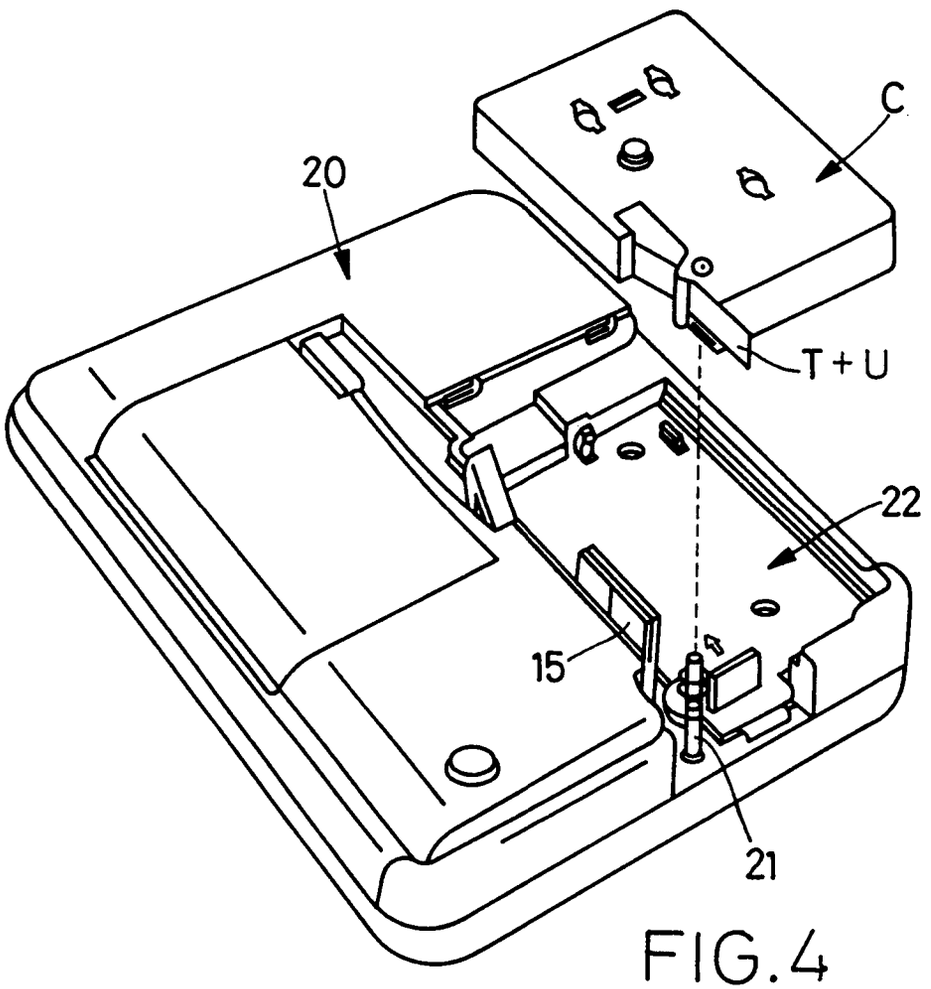
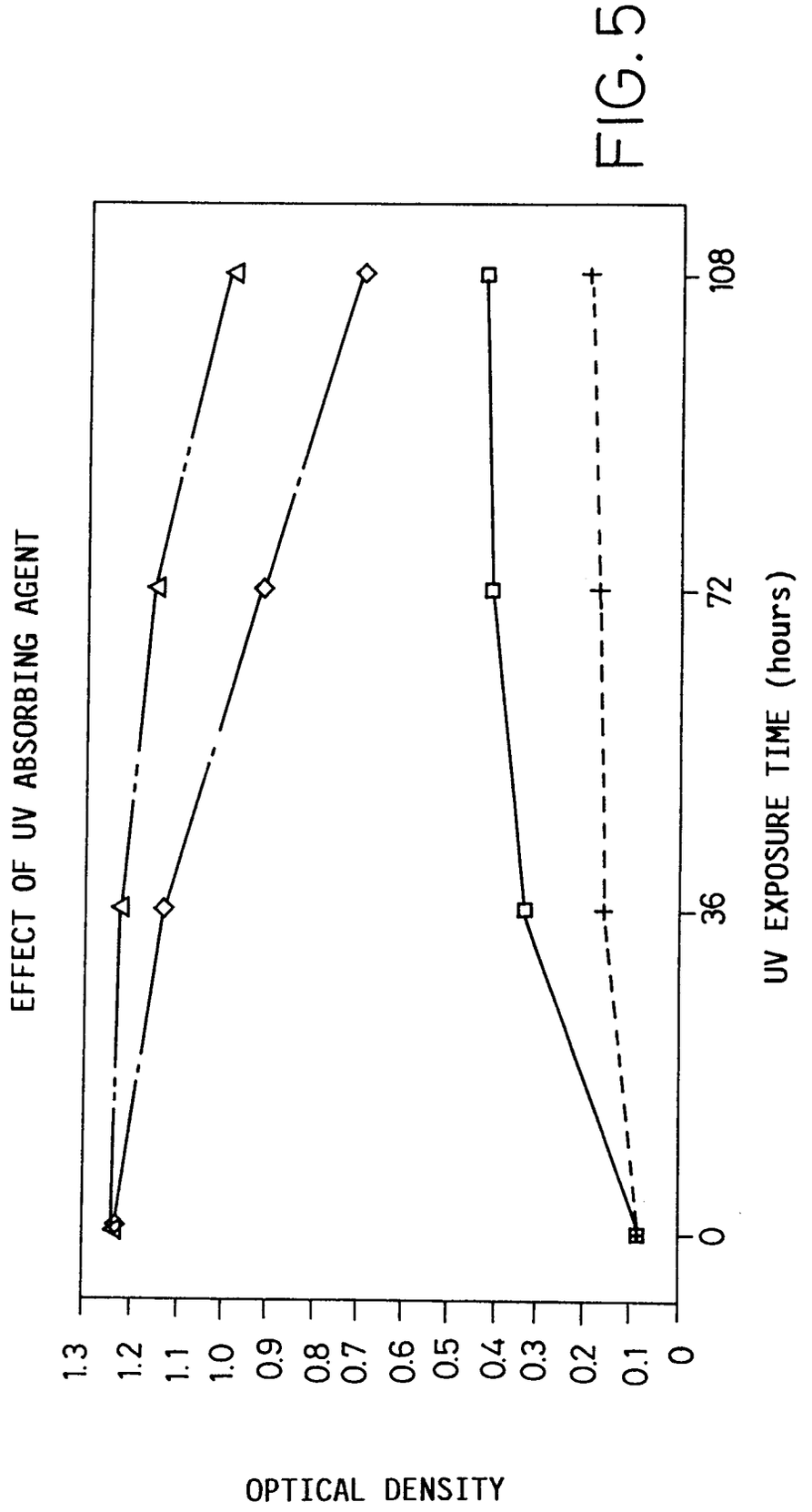


FIG.4

FIG. 5


EFFECT OF UV ABSORBING AGENT
OPTICAL DENSITY
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
36
72
108
UV EXPOSURE TIME (hours)
△ : PRINTED PORTION OF INVENTION SAMPLE No.1
◇ : PRINTED PORTION OF COMPARATIVE SAMPLE No.1
□ : NON-PRINTED PORTION OF COMPARATIVE SAMPLE No.1
+ : NON-PRINTED PORTION OF INVENTION SAMPLE No.1

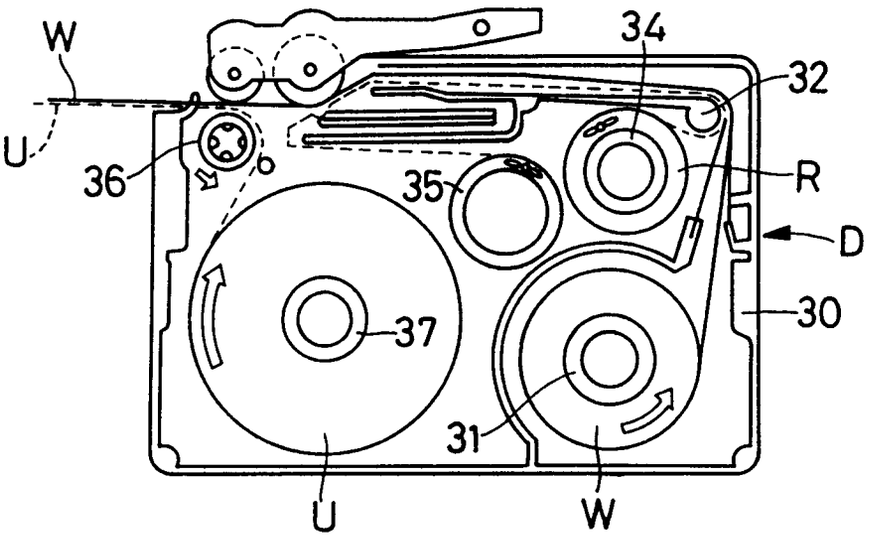


FIG. 6
PRIOR ART

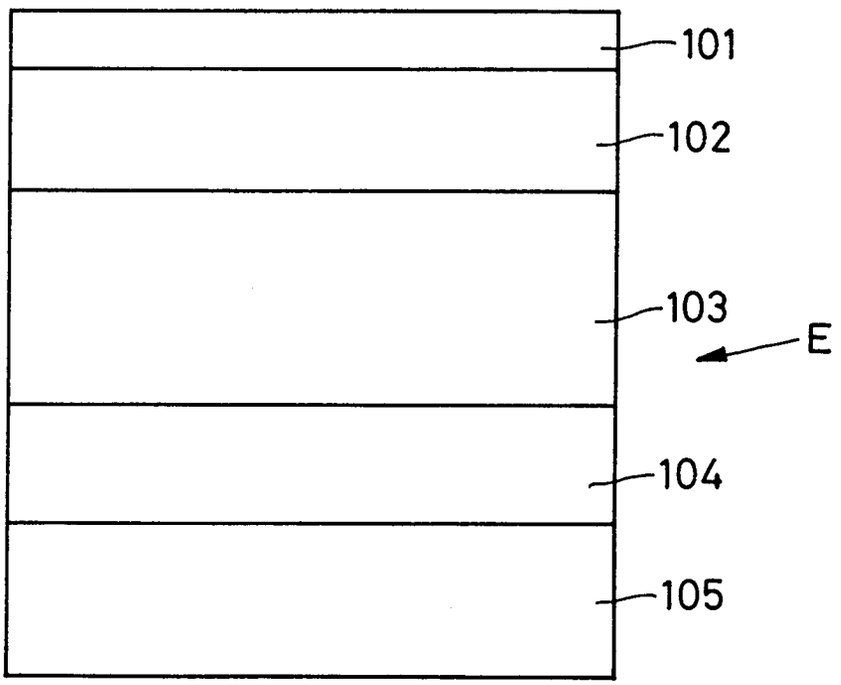


FIG. 7

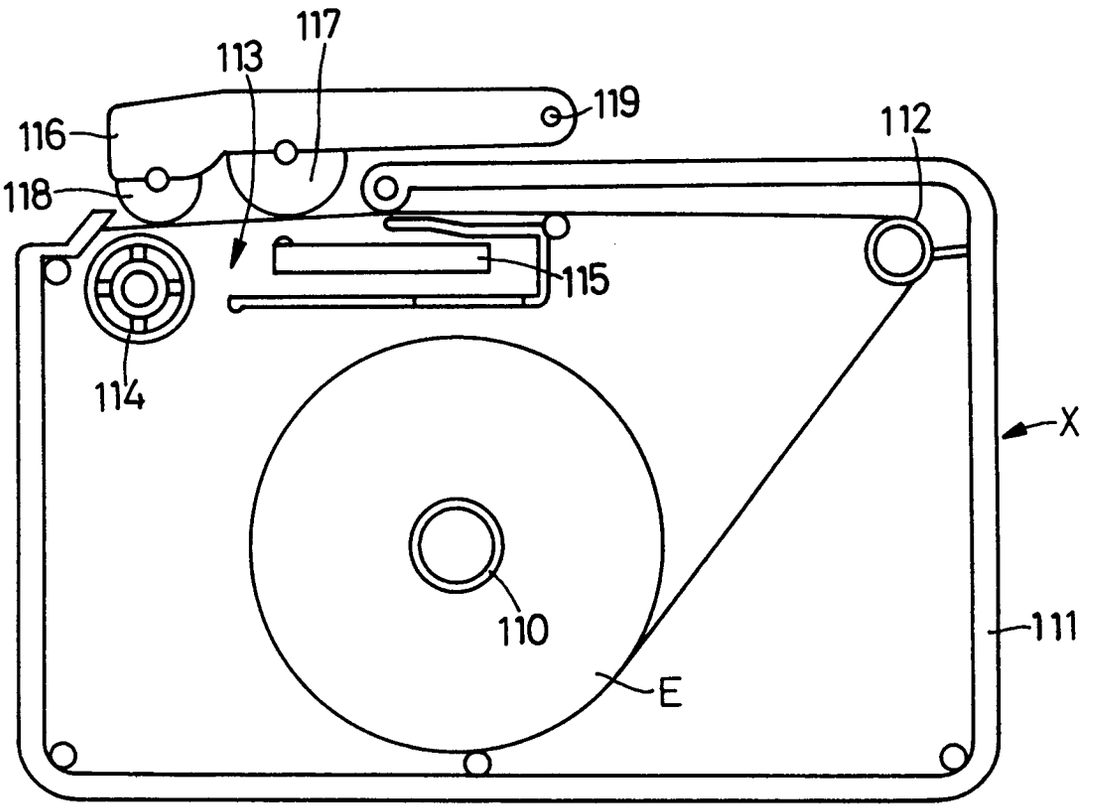


FIG. 8

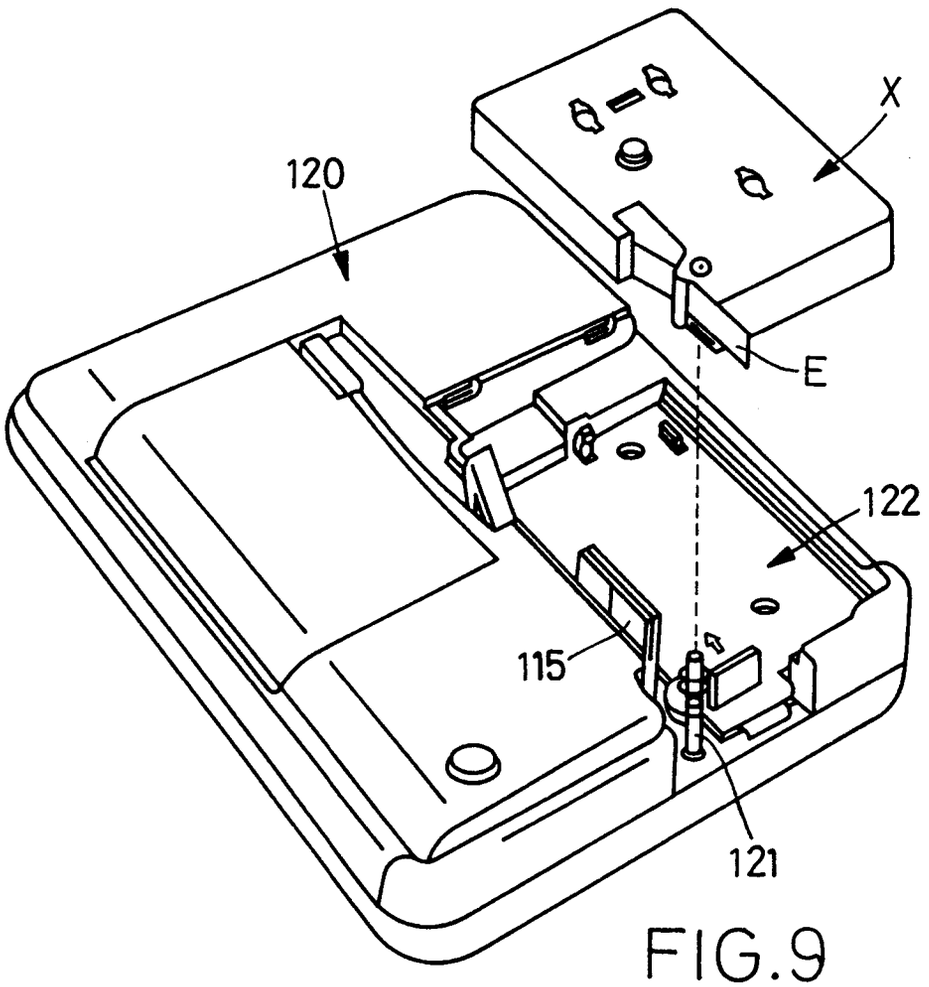
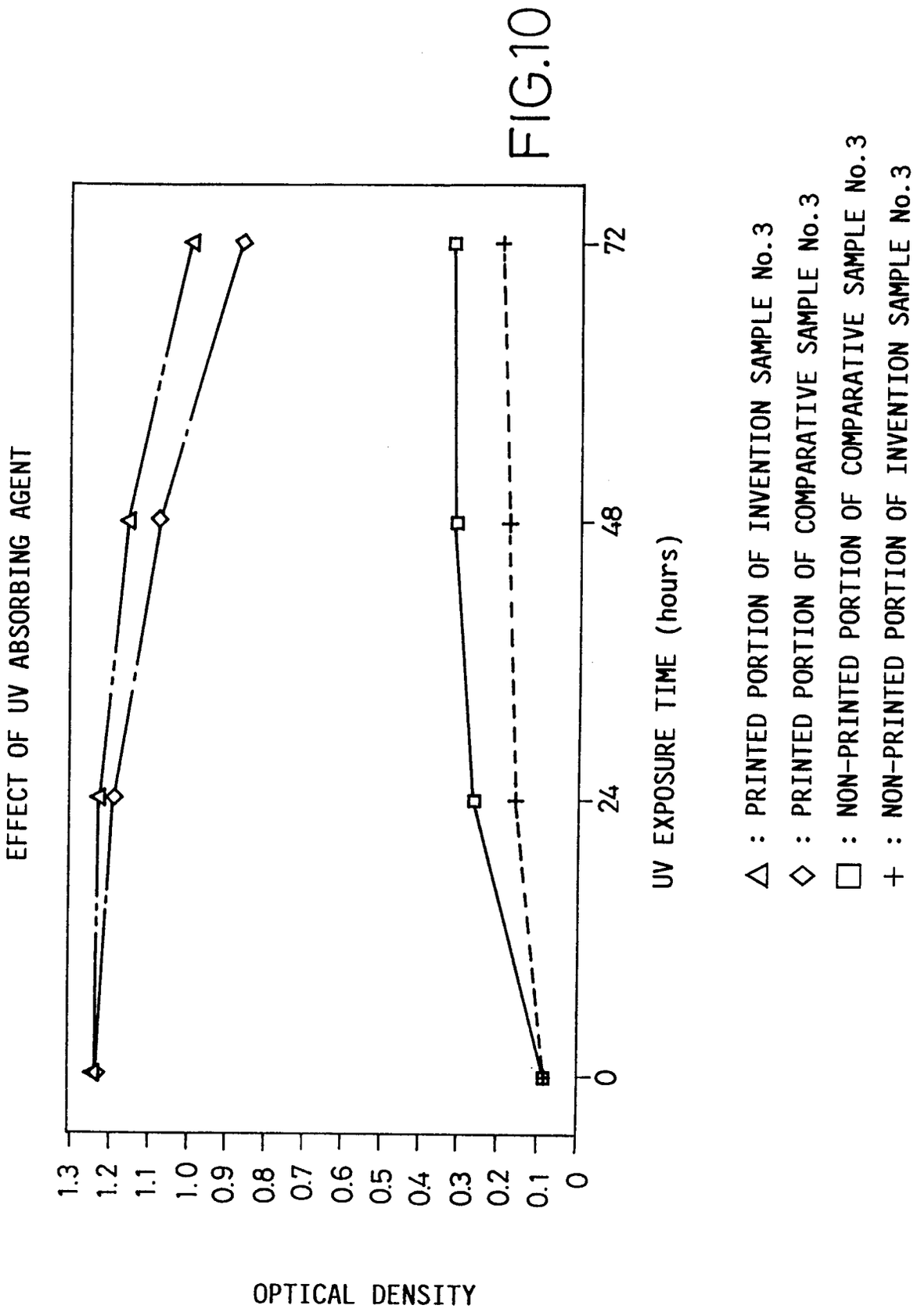


FIG.9

FIG.10


EFFECT OF UV ABSORBING AGENT
OPTICAL DENSITY
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
24
48
72
UV EXPOSURE TIME (hours)
△ : PRINTED PORTION OF INVENTION SAMPLE No.3
◇ : PRINTED PORTION OF COMPARATIVE SAMPLE No.3
□ : NON-PRINTED PORTION OF COMPARATIVE SAMPLE No.3
+ : NON-PRINTED PORTION OF INVENTION SAMPLE No.3

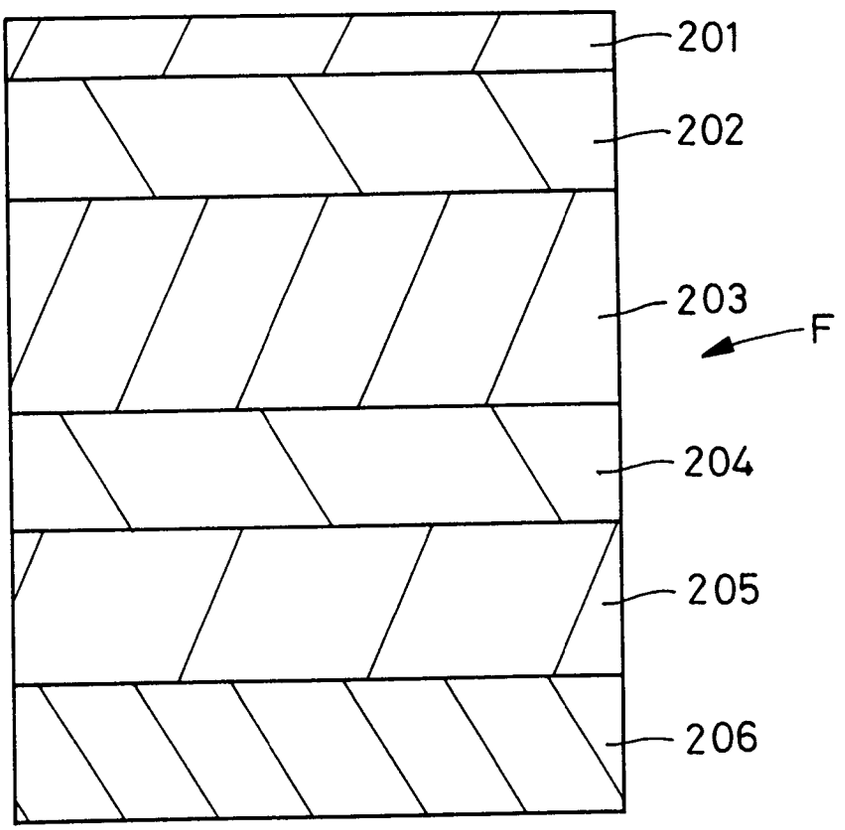


FIG.11

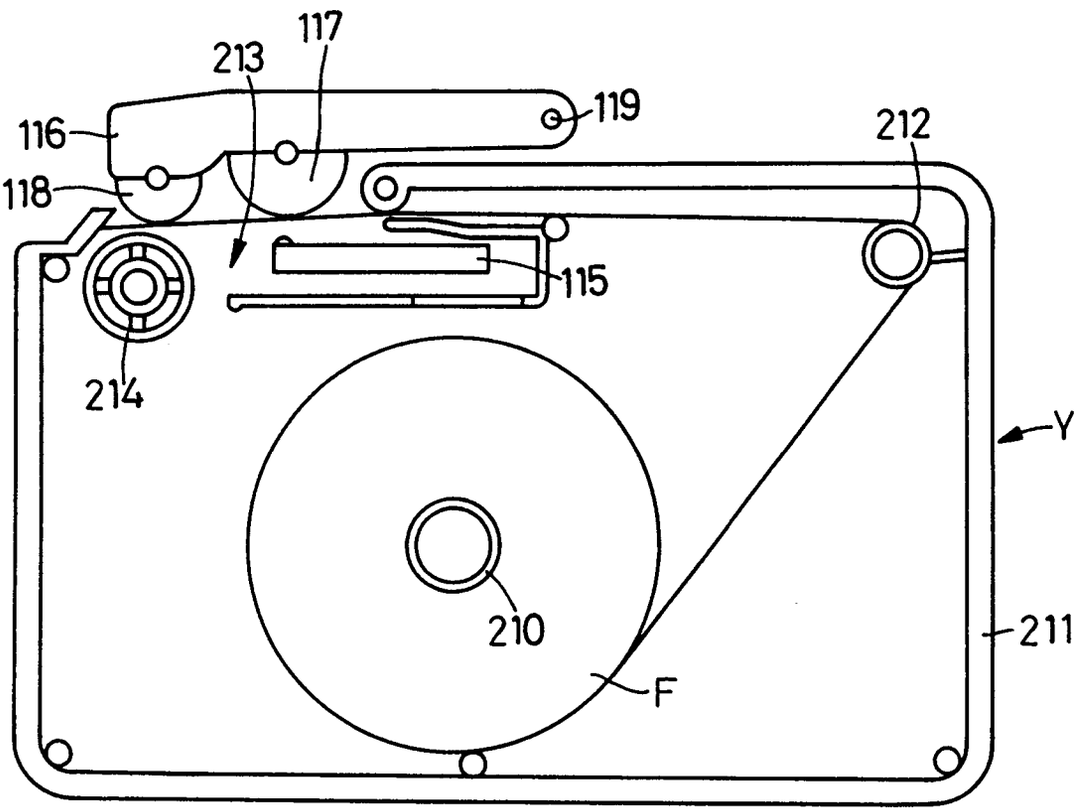
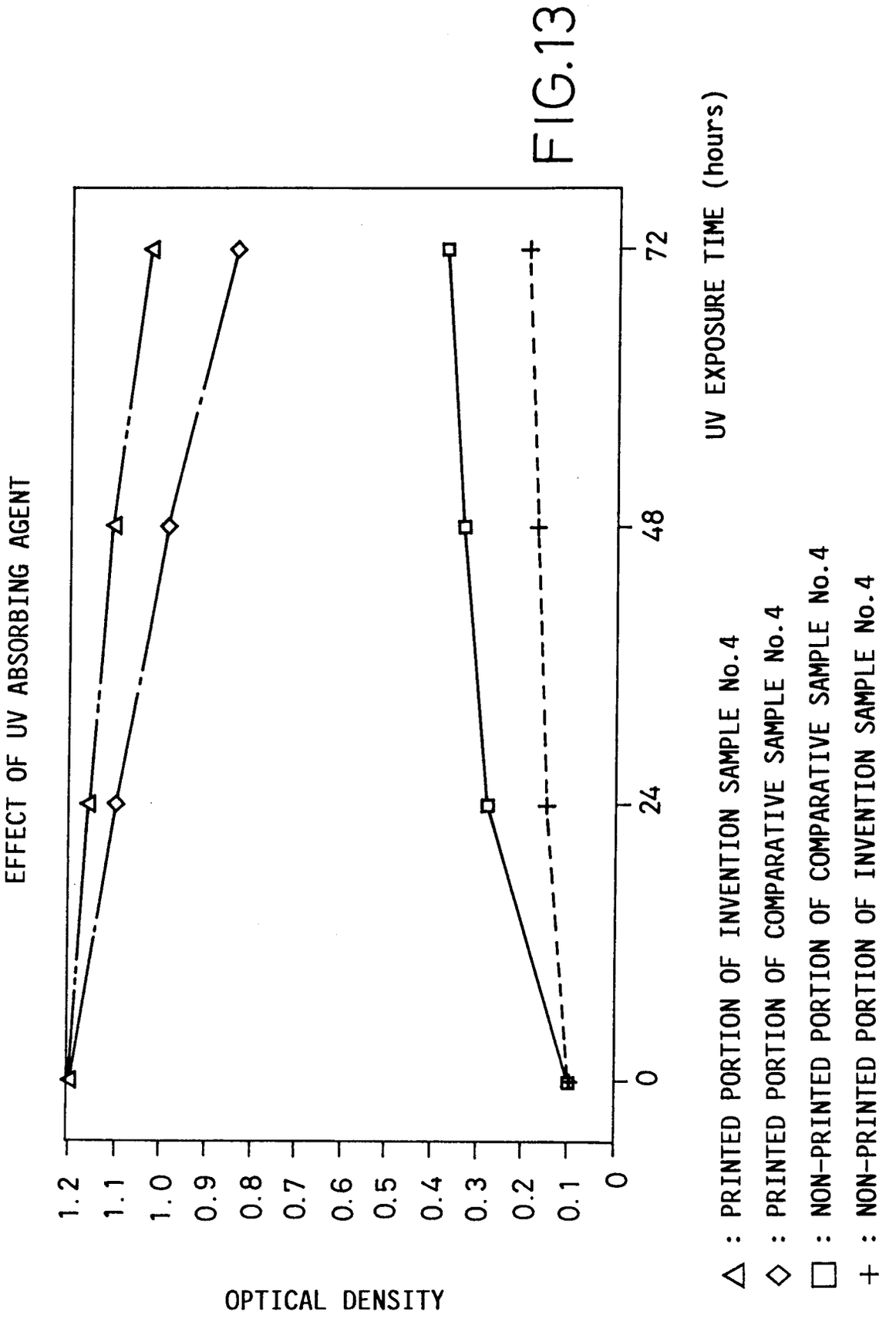


FIG.12

FIG.13


EFFECT OF UV ABSORBING AGENT
OPTICAL DENSITY
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
24
48
72
UV EXPOSURE TIME (hours)
△ : PRINTED PORTION OF INVENTION SAMPLE No.4
◇ : PRINTED PORTION OF COMPARATIVE SAMPLE No.4
□ : NON-PRINTED PORTION OF COMPARATIVE SAMPLE No.4
+ : NON-PRINTED PORTION OF INVENTION SAMPLE No.4

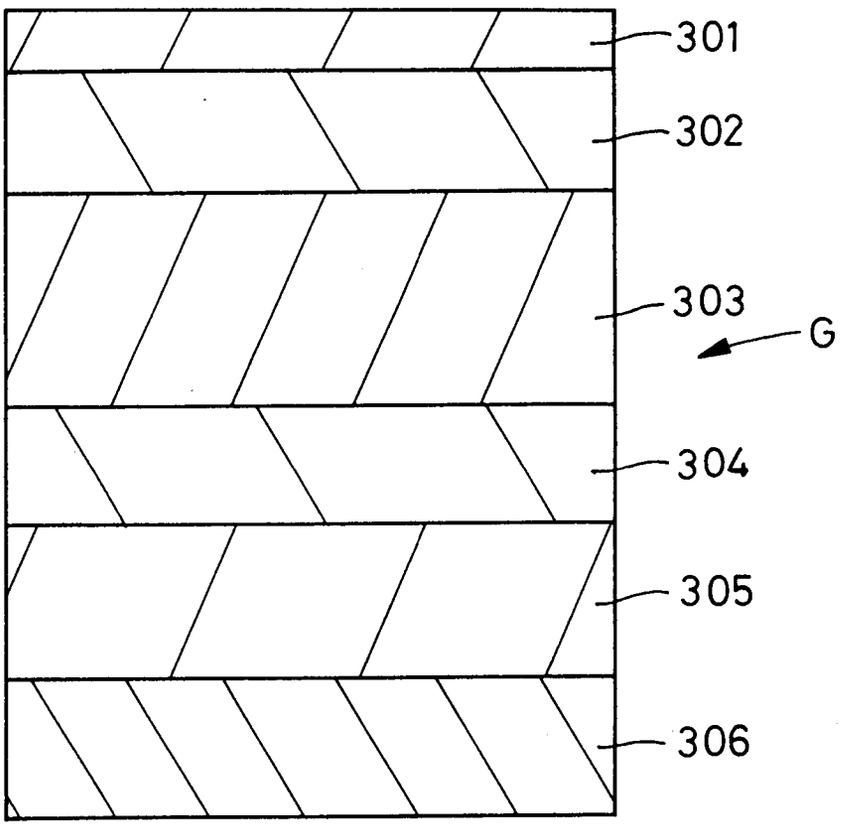


FIG.14

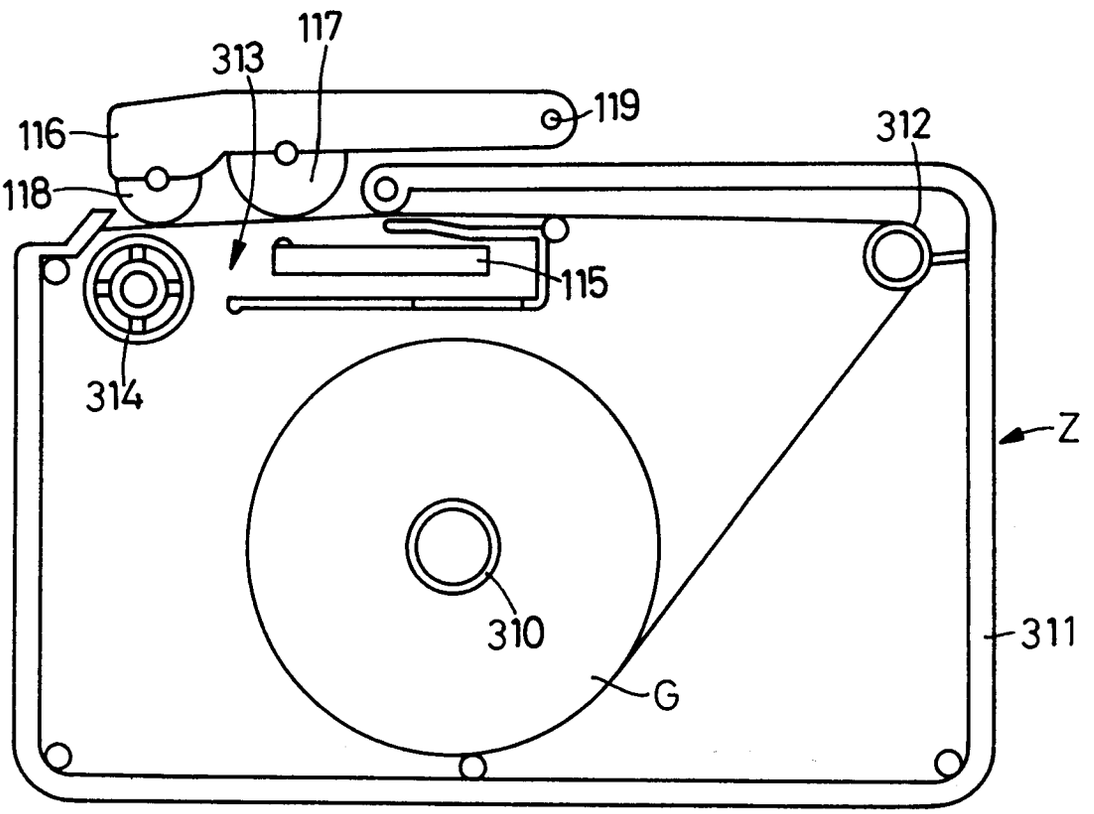
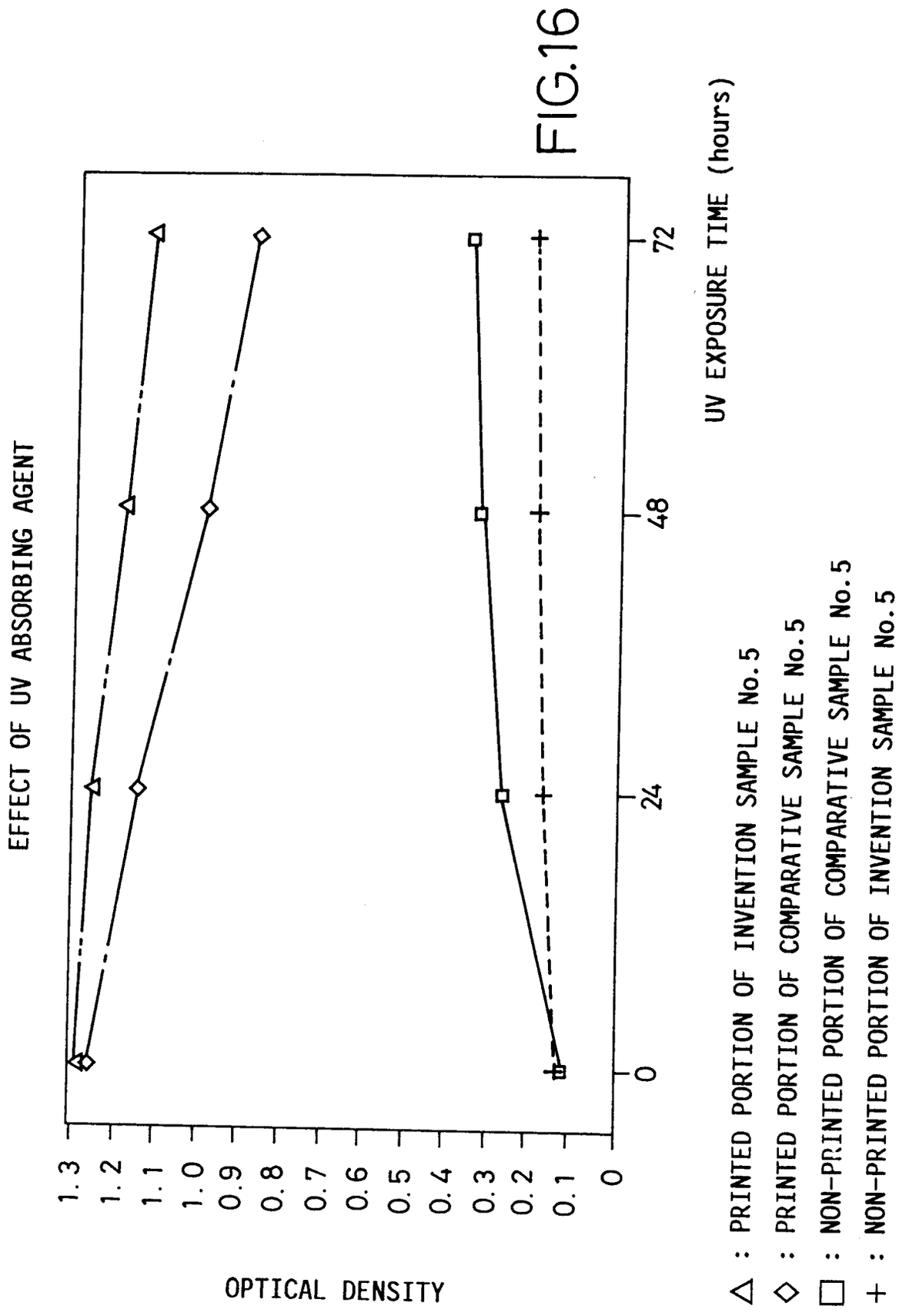


FIG.15

FIG.16


EFFECT OF UV ABSORBING AGENT
OPTICAL DENSITY
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
24
48
72
UV EXPOSURE TIME (hours)
△ : PRINTED PORTION OF INVENTION SAMPLE No.5
◇ : PRINTED PORTION OF COMPARATIVE SAMPLE No.5
□ : NON-PRINTED PORTION OF COMPARATIVE SAMPLE No.5
+ : NON-PRINTED PORTION OF INVENTION SAMPLE No.5

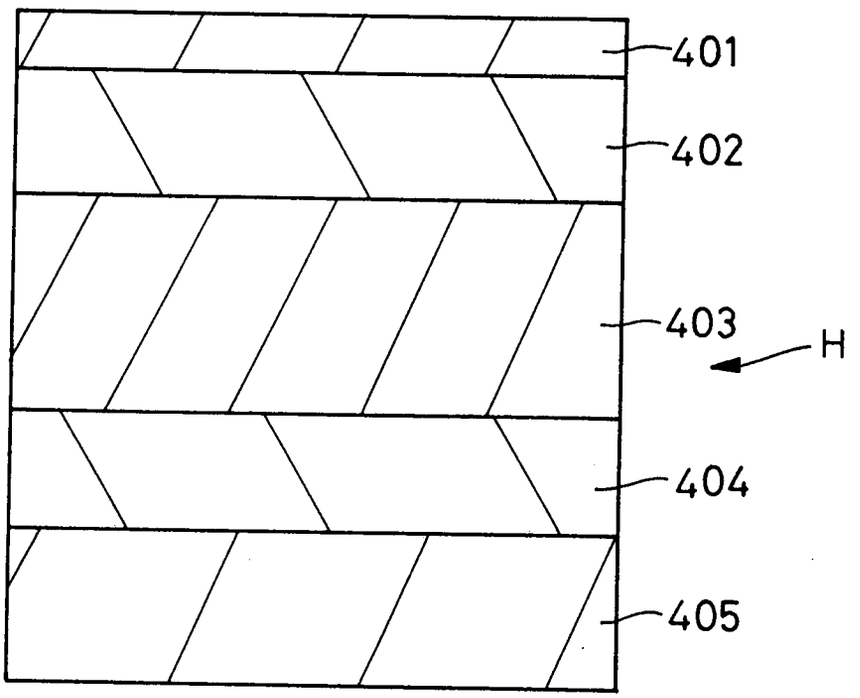


FIG.17

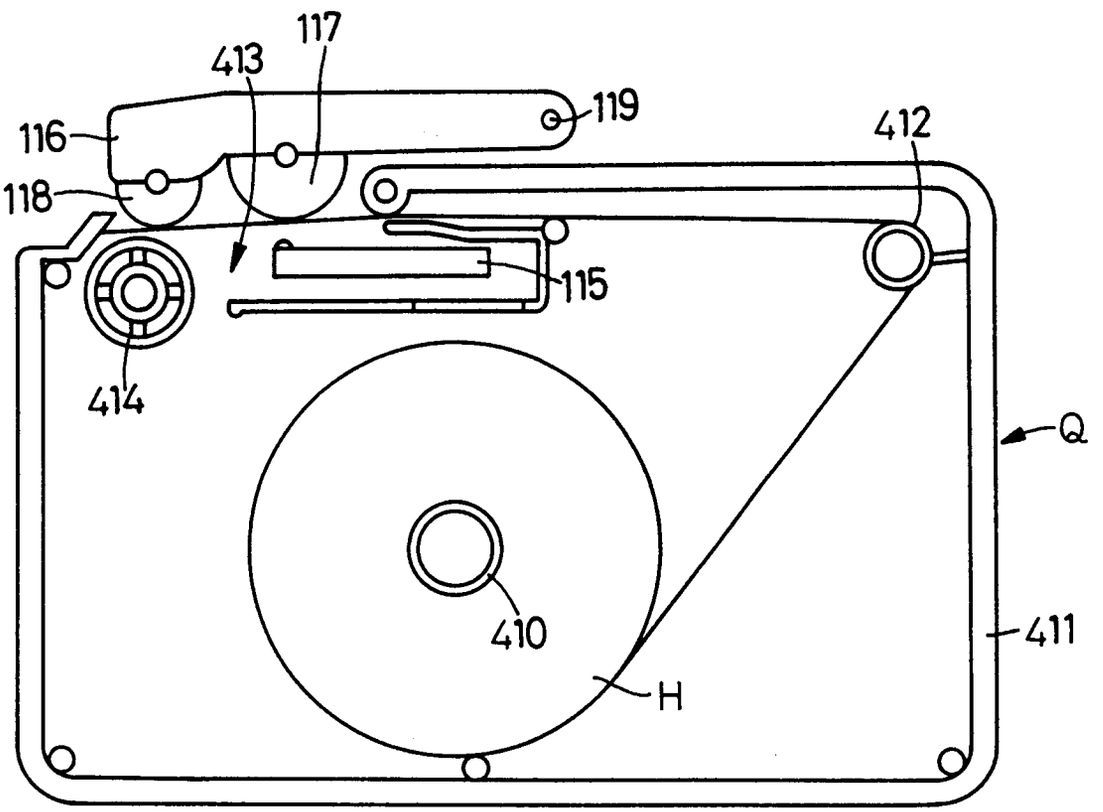
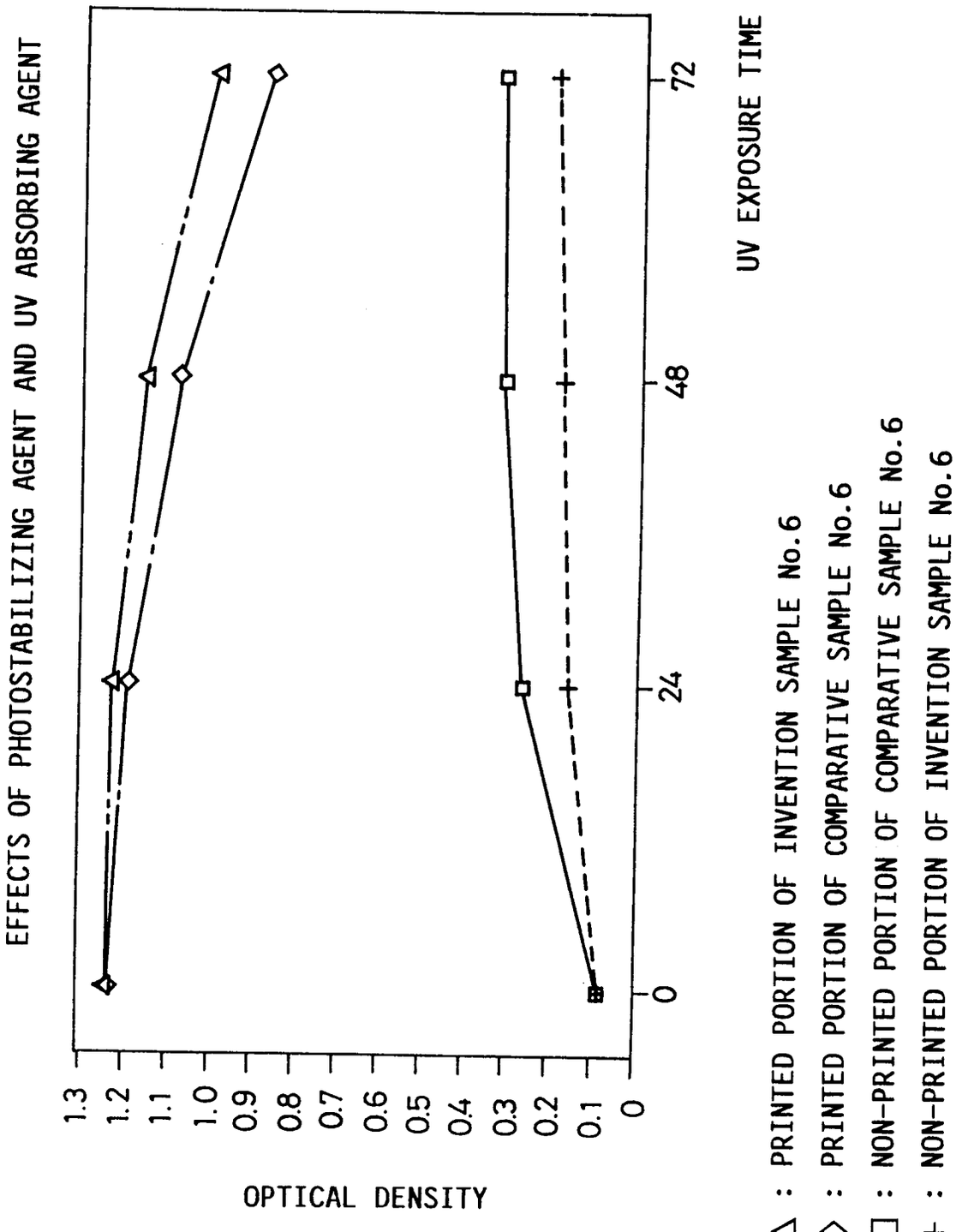


FIG.18

FIG.19


EFFECTS OF PHOTOSTABILIZING AGENT AND UV ABSORBING AGENT
OPTICAL DENSITY
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
24
48
72
UV EXPOSURE TIME (hours)
△ : PRINTED PORTION OF INVENTION SAMPLE No.6
◇ : PRINTED PORTION OF COMPARATIVE SAMPLE No.6
□ : NON-PRINTED PORTION OF COMPARATIVE SAMPLE No.6
+ : NON-PRINTED PORTION OF INVENTION SAMPLE No.6

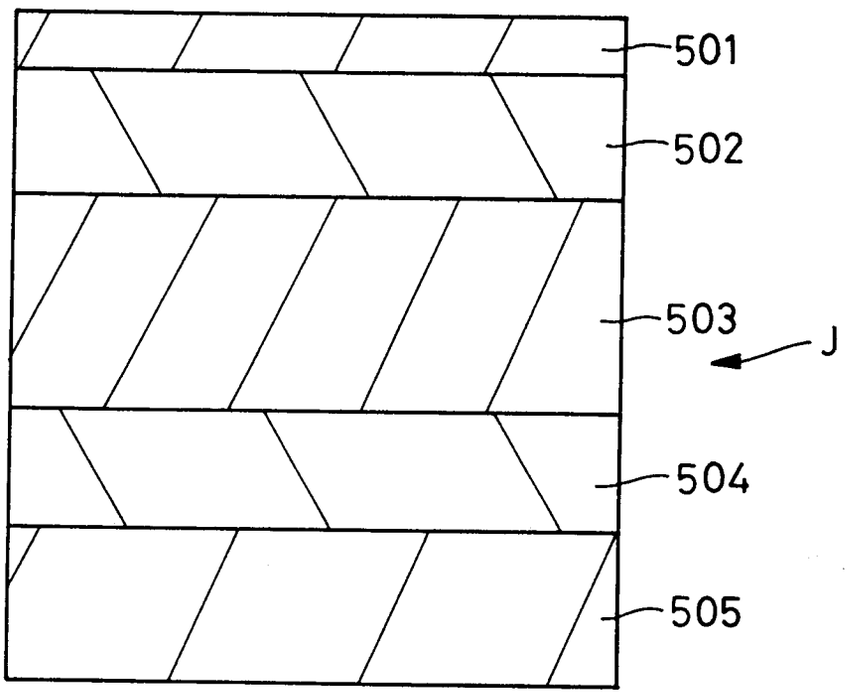


FIG.20

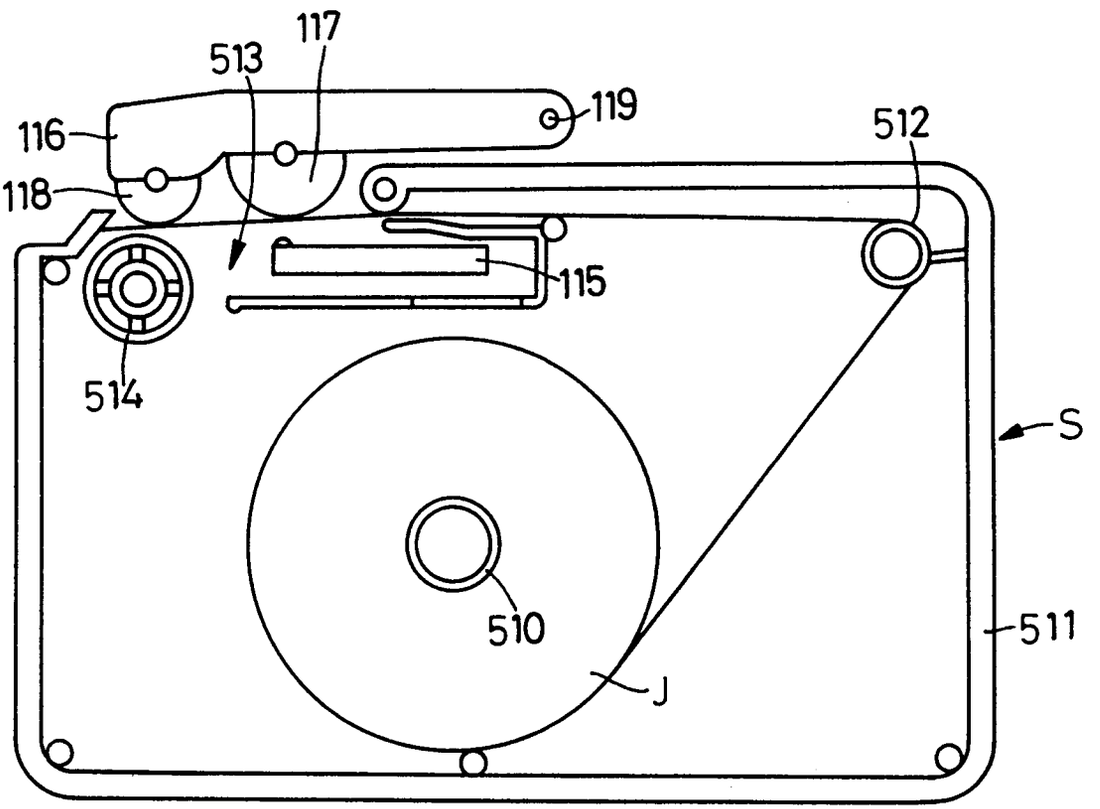
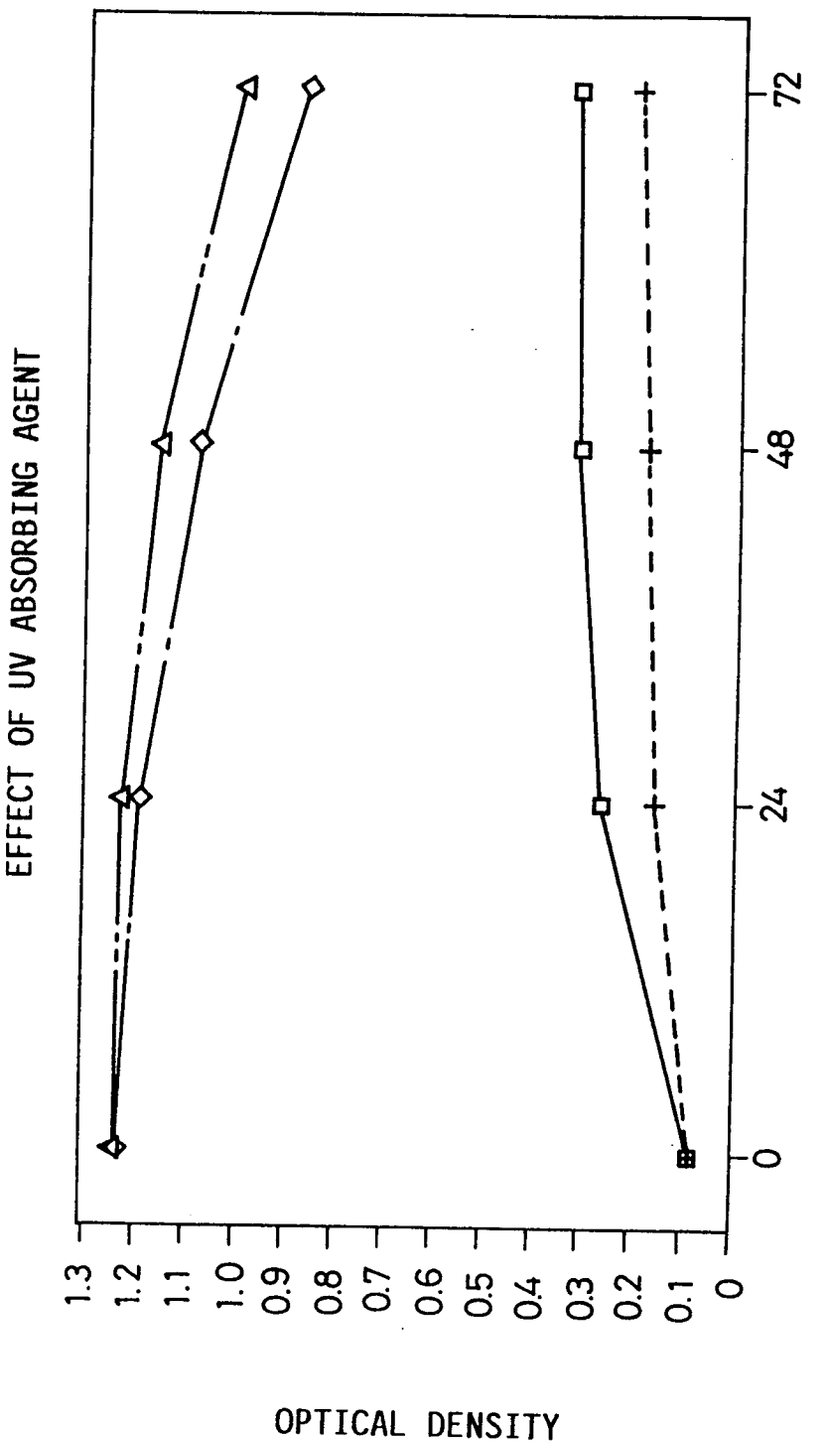


FIG.21

FIG.22


EFFECT OF UV ABSORBING AGENT
OPTICAL DENSITY
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
24
48
72
UV EXPOSURE TIME (hours)
△ : PRINTED PORTION OF INVENTION SAMPLE No.7
◇ : PRINTED PORTION OF COMPARATIVE SAMPLE No.7
□ : NON-PRINTED PORTION OF COMPARATIVE SAMPLE No.7
+ : NON-PRINTED PORTION OF INVENTION SAMPLE No.7