Dec. 12, 1967 L. A. TEUSCHER 3,357,353

VAPOR THERMOGRAPHY RECORDING PROCESS AND RECORDING MEMBER USED THEREIN

Filed Jan. 3, 1966



FIG. 1

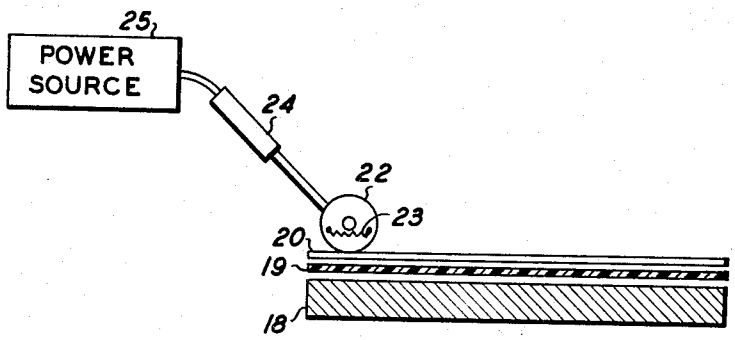


FIG. 2

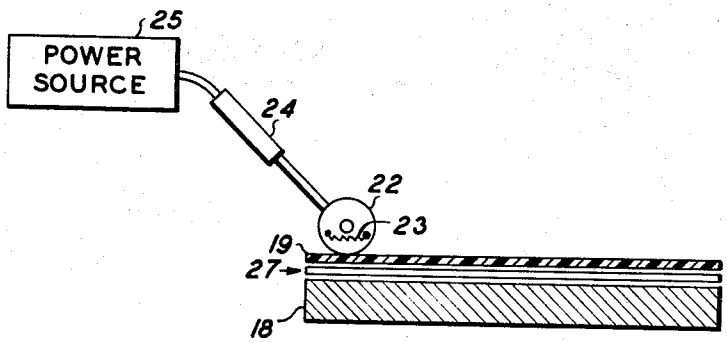


FIG. 3

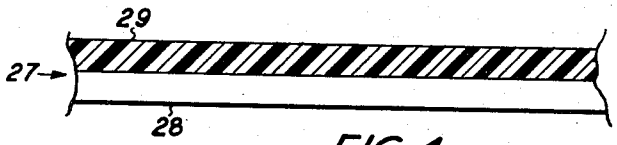


FIG. 4

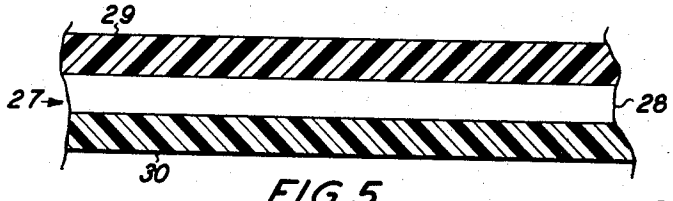


FIG. 5

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VAPOR THERMOGRAPHY RECORDING PROCESS AND RECORDING MEMBER USED THEREIN

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This system relates in general to imaging systems and, more particularly, to improved vapor thermography recording sheets, their manufacture and use.

The tremendous quantity of paper work involved in business and government administration today has created a great need for a system which can reduce the inconvenience, time and expense of producing multiple copies of an original by present methods. For example, carbon paper is conveniently employed to produce multiple copies. Employment of carbon paper not only renders handling more cumbersome, but also contributes to consumption of a great deal of time to correct errors since each carbon copy must be corrected individually. Many duplicating machines are available for duplicating printed and other intelligence by conventional processes such as xerography, photo-copying, thermo and diazo processes. However, each of these processes require complex and expensive apparatus. Less expensive duplicating processes such as spirit-duplicating processes and stencil-duplicating processes are deficient for several reasons. In both of these processes ink or dye stains usually soil the hands and clothes of the operator. The image sharpness of copies made by stencil or spirit duplicating processes is very poor. This loss of sharpness in the case of spirit-duplicating is due to a slight bleeding of the dye caused by the solvent. In the case of stencil duplicating, bleeding occurs in the stencil due to the characteristics of the stencil material which must be so constructed as to permit passage of ink in the character areas. Also, a common characteristic of the less expensive duplicating processes is the requirement of some form of master or stencil which must be prepared as by typing, handwriting, or in a manner similar to that for making an original document and yet, is not suitable for use as an original document.

Recently, a process has been discovered, as disclosed by R. W. Gundlach et al. in U.S. Patent 3,170,395, in which a portion of visible image on an original document may be transferred to a recording sheet rapidly, inexpensively and easily without any loss of image quality in the original. The process involves thermographically transferring a color forming reactant, hereinafter referred to as "Chemical A," to a master sheet and then thermographically transferring a portion of the reaction from the master sheet to a recording sheet. Each thermographic transfer step is accomplished by the vaporization of Chemical A from an image on a first surface followed by condensation of Chemical A in image configuration on a second surface. The recording sheet is uniformly coated or impregnated with a relatively non-volatile co-reactant, hereinafter referred to as "Chemical B," which forms an intensely colored substance when combined with Chemical A. Since Chemical A is transferred between contiguous surfaces, there is no significant loss of resolution. Bleeding effects are practically non-existant because the quantity of reactant transferred is very minute. The use of such reactants in vapor thermography is particularly attractive since a relatively minute quantity of Chemical A in the original document can provide adequate image intensity by reaction with Chemical B in a recording sheet thereby permitting the production of many copies of good image density with only one original document. Further,

the foregoing copies may be made without detectable deterioration of the resolution or image density of the original typed document.

While ordinarily capable of producing good quality images, the process disclosed in the above cited patent suffers from deficiencies in certain areas. When an original carrying thereon an image containing Chemical A is stored in contact with a recording sheet, a part of the original image is transferred to the recording sheet, forming a ghost image. Since it is common practice to file originals and copies of letters pertaining to the same subject together, this off-setting or ghosting cannot be tolerated. The ghosting is caused by sublimation or vaporization of Chemical A from the original onto the surface of a recording sheet where it reacts with the Chemical B therein to form an image. In addition to the above mentioned original-to-copy ghosting problem, when an imaged recording sheet is folded and stored, e.g. as a letter in the mail, there is a certain amount of off-setting of Chemical A from the imaged areas onto clear areas of the recording sheet. Further, off-setting or ghosting occurs between adjacent imaged recording sheets. Although ghosting and off-setting may be eliminated by applying a barrier layer to the recording sheet after image formation, the expensive and complex equipment required to add such a barrier reduces the attractiveness of the process. Recording members, particularly those comprising paper, are subject to decomposition when exposed to various environmental conditions such as moisture, heat and oxygen. Paper sheets will, with the passage of time, become brittle and discolored. The relatively high temperatures employed in the vapor thermography processes accelerate paper decomposition. Further, the color intensity of some images tend to fade upon exposure to the atmosphere.

It is therefore, an object of this invention to provide a recording member overcoming the above noted deficiencies.

It is another object of this invention to provide a recording member which prevents original-to-copy ghosting or off-setting.

It is another object of this invention to provide a recording member which prevents copy-to-copy ghosting or off-setting.

It is another object of this invention to provide a recording member which is resistant to detrimental environmental conditions.

It is another object of this invention to provide a recording member which permits the employment of inexpensive, more compact and simpler copying apparatus.

It is another object of this invention to provide a recording member having physical and chemical properties superior to those of known receiving members.

The above objects and others are accomplished, generally speaking, by providing a recording member carrying on the surface thereof a thermosealing barrier layer which permits the passage of Chemical A therethrough during the image forming process. The thermosealing barrier material becomes impermeable during the last stages of image formation or subsequent thereto. The impermeable barrier layer prevents the migration of Chemical A therethrough and protects the recording member against decomposition.

The specific steps used to render the thermosealing barrier layer of this invention impermeable to Chemical A depends on the type of material employed in the thermosealing barrier layer. For example, continued heating of the imaged recording member may be required when the thermosealing barrier layer comprises a heat hardenable material. Where the thermosealing barrier layer comprises thermoplastic material, cooling may be required to

render the barrier layer impermeable to the passage of Chemical A therethrough.

The advantages of the improved recording member of this invention, its manufacture and use will become apparent upon consideration of the following detailed disclosure of the invention; especially when taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a cross-sectional view of a typewriter ribbon carrying Chemical A;

FIG. 2 is a diagrammatic illustration of simplified apparatus for carrying out one step of the vapor thermographic process;

FIG. 3 is a diagrammatic illustration of the simplified apparatus in FIG. 2 particularly illustrating a second step in the process;

FIG. 4 is a cross-sectional view of one embodiment of a recording member carrying Chemical B;

FIG. 5 is a cross-sectional view of another embodiment of a recording member carrying Chemical B.

For simplicity of illustration, the invention will be described using a typewriter to produce the original. As will be set forth below, however, this is merely by way of example and the invention comprehends various other modes of producing the original.

In producing a typical original in accordance with the instant invention, the conventional typewriter ribbon for a typewriter is replaced with a similar ribbon which has been inked with a mixture of a Chemical A and a contional typewriter ink. Chemical A may comprise one of a number of heat vaporizable chemicals for which a co-reactant, Chemical B, exists so that when the two are combined, an intensely colored material is formed. The following table contains a partial listing of suitable heat vaporizable materials for Chemical A along with corresponding co-reactants, Chemical B:

Chemical A:	Chemical B
(1) Pyrocatechol	(1) Iron salts.
(2) Aniline	(2) Vanadium salts. Potassium dichromate.
(3) Dithiooxamide N-dimethyl-dithiooxamide N,N'-bis(2-hydroethyl)dithiooxamide N,N'-bis(carboxyl-methyl)dithiooxamide Other dithiooxamide derivatives	(3) Copper salts. Nickel salts. Cobalt salts.
(4) Hydrazine Pyrogallol N-(p-hydroxyphenyl)glycine Hydroxylamine Diaminophenol hydrochloride p-Methylaminophenol sulfate Dichlorohydroquinone Thiourea Chlorohydroquinone Bromohydroquinone Gallic acid	(4) Silver salts.
(5) Ammonia salts Ammonium benzoate Ammonium acetate Ammonium carbonate	(5) Organic diazonium salts and coupler.

As will be further described below, originals typed using the ribbon containing Chemical A may be employed to form a mirror image master from which, in turn, multiple direction reading copies may be produced on paper treated with the corresponding Chemical B and overcoated with a thermosealing barrier.

In FIG. 1, the typewriter ribbon comprises support tape **15** carrying composition **16** of Chemical A and ink. Support tape **15** may comprise any suitable material such as fabric, metal foil, paper, or plastic. Because non-uniformities are emphasized in a duplicating process, the support tape **15** is preferably constructed of material that facilitates uniform typing. As is well known in the typewriter industry, greater uniformity is commonly achieved by using a non-reusable ribbon. Such ribbons are conventionally referred to as "carbon ribbons" and employ a thin plastic support tape. In a preferred embodiment, typewriter ribbon for use in accordance with the present invention comprises a polyethylene film coated with a mixture of typewriter ink and about 10 to 50% based on the weight of the ink, of Chemical A. Spray coating, roll coating, dip coating, vapor coating or any other suitable coating means may be employed to coat the typewriter ribbon.

FIG. 2 shows a simple manually operated embodiment of an apparatus to produce multiple copies of the typed original. This apparatus comprises a heat conductive pad **18** such as will maintain a uniform low ambient temperature on its surface when a heated roll is rolled across a sheet of material resting on such surface Thus, the heated conductive pad may comprise a metal such as aluminum having sufficient mass to absorb a considerable amount of heat without changing its overall temperature by a significant amount. This pad should have a surface area adequate to support the largest size of recording sheet thay may be desired. A rectangular size of about 10 x 15 in. is adequate for most purposes. The pad should preferably be not less than about ¼ in. thick, but this is not limiting since it is the heat absorption and dissipation characteristics which are controlling.

In accordance with the inventive process, master sheet **19** is positioned in contact with the surface of the heat conductive pad **18**. This master sheet may be constructed from substantially any material that can be finished to a smooth surface such as metal foils, glass, paper, and plastic materials, e.g., a 1 mil thick sheet of cellulose acetate. Non-porous materials have generally yielded the best results but whether this is due to thermal characteristics, absorption characteristics, or other characteristics is not fully understood at this time. The determining criteria relevant to the thickness of the master sheet is the amount of heat available and the permissible time for vaporizing Chemical A from the surface of the master sheet. Satisfactory images have been obtained with sheets of 1 mil and of 15 mils thickness. Depending on the material employed, an excessive thickness will either act as a heat insulator or will dissipate the heat too rapidly for efficient operation. A thickness of less than about 10 mils is preferred because less heat energy is required.

Typed original **20** is placed face down against the smooth surface of the master sheet **19** and heated roller **22** or other heat applicators such as a heated plate or heat lamp is used to apply heat against the back of typed original **20**. Heat applicator **22**, as illustrated, is a metal roller containing thermal element **23** which is connected through handle **24** of the roller to power source **25**. In rolling the roller **22** against the back of the typed original **20** or in applying heat in one of the other ways suggested, the intensity of the heat and the length of heating time must be such as to cause a portion of Chemical A in the characters of the typed original to sublime or otherwise change to a vapor. Suitable heat may be applied by operating the roller **22** at a temperature of about 200 to 400° F. and by rolling the heated roller across the back of original **20** at a speed of about 1/10 to 4 in. per second. With the roller at 240° F., a speed of about ¾ in. per second may be employed. These ranges are suitable when Chemical A is rubeanic acid. While still higher temperatures produce good results at faster speeds, such temperatures increase the likelihood of heat damage to the materials or equipment. Safeguards against such damage can be built in, but would increase expense. In the apparatus of FIG. 2, heat conductive pad **18** maintains master sheet **19** at a temperature relatively lower than that attained by typed original **20** when the heat is applied to it. Thus, a

portion of Chemical A is vaporized from the typed original and condensed on the master sheet. Since the material thus transferred is transferred between surfaces that are in contiguous contact, there is no significant loss of resolution. Bleeding effects are practically non-existant because the quantity of vapor transferred is very minute.

After Chemical A has been thermographically transferred to master sheet **19** as described above in connection with FIG. 2, the master sheet is removed from pad **18**. Then as illustrated in FIG. 3, the improved recording member **27** of this invention treated with Chemical B is positioned on pad **18**. The improved recording member **27** of this invention may comprise a base or support element **28** having thereon a layer **29** of thermosealing barrier material as illustrated in FIG. 4. Since the function of the base is to provide a physical support for the thermosealing barrier material, it is evident that a wide variety of organic or inorganic materials may be employed in the base. Alternatively, the recording member **27** may comprise a base element **28** sandwiched between a thermosealing barrier layer **29** and another layer **30** which may or may not possess thermosealing properties. Layer **30** may be employed to prevent escape of Chemical A, if any, which may migrate through base element **28**. An impervious layer **30** is particularly desirable when base element **28** is relatively porous. Where base element **28** is relatively impervious to passage of Chemical A therethrough, layer **30** may comprise thermosealing barrier material to permit 2-sided duplication. Chemical B may be dispersed throughout the base element or sandwiched between the thermo-porous layer and the base element. With the treated recording member **27** lying on pad **18**, master sheet **19** is positioned in face-to-face contact with the recording member so that the image carrying surface of the master sheet is in contact with the thermosealing barrier layer of the recording member. When a heated roller **22** or similar heat applicator applies heat to the image free surface of the master sheet, a portion of Chemical A is transferred in image configuration by evaporation to the thermosealing barrier layer surface of the recording member. Simultaneously, heat from the roller **22** effects a sufficient temperature rise in the thermosealing barrier layer to allow passage of Chemical A vapors therethrough. The vaporized Chemical A contacts and reacts with co-reactant Chemical B, behind the thermosealing barrier layer to produce a visible image.

Since transfers by the process described above are by substantially contiguous contact, and since the insoluble Chemical A-Chemical B colored reaction product does not bleed, a very high resolution image is obtained in the final copy.

In a further embodiment of this invention, it is possible to eliminate the master sheet and form a copy directly from the original. This may be accomplished, for example, by positioning the recording member of this invention having a transparent base element in face-to-face contact with a typed surface of the original. The two are heated to vaporize Chemical A. Continued heating allows Chemical A to penetrate the thermosealing barrier layer and react with Chemical B. The resulting image is directly readable through the base element from the reverse side of the recording member. Various other embodiments of this invention relating to methods of transferring Chemical A from an original to the recording member with or without an intermediate transfer to a master sheet are described in U.S. 3,170,395, the disclosure of which is incorporated into the instant specification by reference.

As described above, the treated recording members of this invention comprise a base carrying thereon a layer of thermosealing barrier material. The physical shape or configuration of the recording member may be in any form whatsoever as desired by the formulator such as flat, spherical or cylindrical.

Obviously where the recording member is non-planar, it may be desirable to employ a master or original having a transfer surface which will conform to the image receiving surface of the thermosealing barrier layer. The recording member, master and/or oiginal may be flexible or rigid. The base element employed to support the thermo-porous layer may be coated or impregnated with Chemical B. The base may comprise any porous or impervious material such as metal, plastic or paper. When paper is employed as a base, it is preferred that the paper possess a smooth surface to permit a plane wherein all points thereon are substantially equidistant from the external surface plane of the thermosealing barrier layer. Recording members of this type are preferred because geater image uniformity at high copying speeds are achieved. The base element may be coated with Chemical B by spraying, dipping, flowing, rolling, wiping or any other suitable process. Some moisture content in the base element has been found to increase image density. Thus, casein coated paper or papers treated with a humectant such as sorbitol or glycerine have been found advantageous. Although it is obviously preferable to employ a completely impermeable base sheet of the type which will not allow penetration of heat volatilizable Chemical A from one side of the receiving member to the other so as to prevent formation of ghost images on the back side of the recording member, a certain amount of this ghost imaging on the back side of the receiving member is tolerable where copy cost is paramount, and inexpensive copy sheets must be employed.

As described above, the thermosealing barrier layer must permit passage of the heated vapors of Chemical A therethrough during the imaging process. Hence, the thermosealing barrier layer must be sufficiently porous to permit passage therethrough at at least about the elevated vaporization temperature of Chemical A. The thermosealing barrier material may comprise a heat softenable material or a heat settable material. However, the thermosealing barrier material must become substantially impermeable to Chemical A vapors during the last stages of image formation or shortly thereafter. The thermosealing barrier layer may comprise various materials and/or structures. A continuous layer of a normally solid thermoplastic organic or inorganic compound or composition which is sufficiently fluid at the vaporization temperature of Chemical A to permit the vapor pressure of Chemical A to force bubbles of Chemical A vapors therethrough may be employed. To conserve material, reduce cost and increase speed, the barrier layer should be kept as thin as possible without sacrificing subsequent impermeability. A thickness of about 0.5 micron to about 250 microns has been found satisfactory although thicker or thinner layers may be used. Upon subsequent cooling, a liquified thermoplastic barrier material will solidify and prevent ghosting and off-setting. Alternatively, a thermosetting material which has not progressed beyond the thermoplastic stage (e.g., phenol-formaldehyde resin in the A-stage) may be employed. As to the latter material, sealing is accomplished by continued heating at the same or different temperature until the material reaches a thermoset stage. The physical structure of the thermosealing barrier may be so constructed as to render the barrier layer porous at room temperature. In this case, the themosealing barrier layer material must possess a melting point which permits the structure to become sufficiently fluid to coalesce and become impervious during the latter stages of the imaging process or during a subsequent heating step. The porous physical structure of the thermosealing barrier layer may be formed by a number of different methods. For example, a thin foraminous mat of fine thermoplastic fibers may be deposited on the base element. The weight of the fibers deposited per unit area should be regulated to permit the formation of a continuous film when the fibers are fused. The porous layer may also be formed by sintering a layer of finely divided thermoplastic particles on the base element. Another method for forming a porous thermosealing barrier

layer is by coating the base element with a thermoplastic material which contains solvent soluble or gas forming solid particles and then leaching the solvent soluble particles of gasifying the gas forming particles from the thermoplastic material. A sufficient quantity of soluble or gas forming solid particles should be employed to permit the formation of interconnecting voids in the thermosealing barrier layer. A thermoplastic coating on a base element may be rendered porous by softening the thermoplastic coating with a solvent or by heat, applying gasifiable or solvent soluble solid particles having sufficient density to sink into the thermoplastic coating, and then removing the solid particles by means of heat or suitable solvents. Where a continuous thermosealing barrier layer contains a high-melting point thermoplastic resin which does not melt at about the vaporization temperature of the specific Chemical A employed, a solid plasticizer or solvent may be mixed with the thermoplastic resin. The solid plasticizer or solvent should melt at about the vaporization point of Chemical A. Further, the solid plasticizer or solvent should not affect the thermoplastic resin at room temperature. Any suitable solid solvent may be employed. Typical solid solvents include: tetramethyl benzene, naphthalene, anthracene, naphthylamines, and stearic acid amides. Although it is not clear, it is believed that when the solid plasticizers of this invention are heated above their melting point, they weaken the Van der Waal hydrogen bonding, and dipole-to-dipole forces existing in the thermoplastic polymers and allow slippage of the long linear polymer chains thereby promoting fluidity at lower temperatures and rendering the thermoplastic resin permeable to Chemical A vapors. When cooled back to room temperature, the thermoplastic resin seals itself preventing further passage of Chemical A. Any suitable solid plasticizer may be employed. Typical solid plasticizers include: acetamide, ethylene glycol dibenzoate, dimethyl isophthalate, N-cyclohexyl p-toluene sulfonamide, N-ethyl-p-toluene sulfonamide, triphenyl phosphate glycerol tribenzoate, dicyclohexyl phthalate, diphenyl phthalate and blends thereof.

The following examples further define, describe and compare methods of preparing the developers of the present invention and of utilizing them to develop electrostatic latent images. Parts and percentages are by weight unless otherwise indicated.

In the following, Examples I–IX and X–XVI are carried out with substantially identical paper sheets treated with a 25% aqueous solution of nickel sulphate. All originals are typed in an electric typewriter employing a polyethylene ribbon coated with an ink containing 20% dithiooxamide, based on the weight of the ink. Imaging in Examples I–VIII and X–XVI is accomplished by vaporizing dithiooxamide from an imaged original to a master and then transferring the vapors from the imaged master to the recording member by means of a heated roller as illustrated in FIGS. 2 and 3. The overcoatings in Examples II–IX and XI–XVII are applied with a rod wound with 14 gauge wire.

Example I

A control sample of non-imaged nickel sulphate treated paper is placed in face-to-face contact with an original having dithiooxamide characters typed thereon. After storage for three weeks at room temperature (about 70° F.), the nickel sulphate paper is separated from the original and examined. An image corresponding to the original is formed on the nickel sulphate treated paper.

Example II

A non-imaged nickel sulphate treated paper is coated with a solution of 20% rosin-modified phenol-formaldehyde resin (Amberol 71) in toluene. The coated paper is then placed in face-to-face contact with an original having dithiooxamide characters typed thereon. After storage under conditions substantially identical to that set forth in Example I the coated paper is separated from the original and examined. No image is formed on the coated sheet.

Example III

A non-imaged nickel sulphate treated paper is coated with a solution of 5% polyvinyl chloride (Escambia 1185) and methyl ethyl ketone. The coated paper is then placed in face-to-face contact with an original having dithiooxamide characters typed thereon. After storage under conditions substantially identical to that set forth in Example I, the coated paper is separated from the original and examined. No image is formed on the coated sheet.

Example IV

A non-imaged nickel sulphate treated paper is coated with a solution of 28.5% phenol resin (Phenolic CKM 5254) in xylene. The coated paper is then placed in face-to-face contact with an original having dithiooxamide characters typed thereon. After storage under conditions substantially identical to that set forth in Example I, the coated paper is separated from the original and examined. No image is formed on the coated sheet.

Example V

A non-imaged nickel sulphate treated paper is coated with a solution of 10% VYNS resin (90% vinyl chloride and 10% vinyl acetate) in dichloroethylene. The coated paper is then placed in face-to-face contact with an original having dithiooxamide characters typed thereon. After storage under substantially identical conditions to that set forth in Example I, the coated paper is separated from the original and examined. No image is formed on the coated sheet.

Example VI

A non-imaged nickel sulphate treated paper is coated with a solution of 5% polyvinyl chloride (Escambia 1250) in methyl ethyl ketone. The coated paper is then placed in face-to-face contact with an original having dithiooxamide characters typed thereon. After storage under conditions substantially identical to those set forth in Example I, the coated paper is separated from the original and examined. No image is formed on the coated sheet.

Example VII

A non-imaged nickel sulphate treated paper coated with a solution of 15% polyvinylidene chloride (Saran F–220) and 7% acetamide (a normally solid plasticizer) in methyl ethyl ketone. The coated paper is then placed in face-to-face contact with an original having dithiooxamide characters typed thereon. After storage under conditions substantially identical to that set forth in Example I, the coated paper is separated from the original and examined. No image is formed on the coated sheet.

Example VIII

A non-imaged nickel sulphate treated paper is coated with a solution of 10% polyvinyl chloride resin and 4% diphenyl phthalate (a normally solid plasticizer) in methyl ethyl ketone. The coated paper is then placed in face-to-face contact with an original having dithiooxamide characters thereon. After storage under conditions substantially identical to that set forth in Example I, the coated paper is separated from the original and examined. No image is formed on the coated sheet.

Example IX

A non-imaged silver behanate treated paper is coated with a solution of 15% polyvinylidene chloride (Saran F–220) and 5% durene (a normally solid solvent) in methyl ethyl ketone. The coated paper is then placed in face-to-face contact with an original having pyrocatechol characters typed thereon. After storage for three weeks at 80° F., the paper is separated from the original and examined. No image is formed on the coated sheet.

Example X

A control sample of non-imaged nickel sulphate treated paper sheet, hereinafter designated "paper X" is imaged with dithiooxamide vapors transferred from an imaged master. The imaged control sample, paper X is then placed in face-to-face contact with a second non-imaged nickel sulphate treated paper sheet, hereinafter designated "paper Y" and stored for three weeks at 80° F., after storage, the second non-imaged sheet, paper Y is separated from the imaged sheet, paper X, and examined. An image corresponding to the image on paper X is formed on paper Y.

Example XI

Two non-imaged nickel sulphate treated paper sheets are coated with a solution of 20% rosin-modified phenol-formaldehyde resin (Amberol 71) in toluene. One coated paper sheet is imaged with dithiooxamide vapors transferred from an imaged master. The coated and imaged paper is then placed in face-to-face contact with the second non-imaged, but similarly coated paper sheet. After storage under conditions substantially identical to those set forth in Example X, the coated but non-imaged paper is examined. No image is found.

Example XII

Two non-imaged nickel sulphate treated paper sheets are coated with a solution of 28.5% phenolic resin (Phenolic CKM 5254) in xylene. One coated paper sheet is imaged with dithiooxamide vapors transferred from an imaged master. The coated and imaged paper is then placed in face-to-face contact with the second non-imaged, but similarly coated sheet. After storage under conditions substantially identical to that set forth in Example X, the coated but non-imaged paper is examined. No image is found.

Example XIII

Two non-imaged nickel sulphate treated paper sheets are coated with a solution of 10% VYNS resin (90% vinyl chloride and 10% vinyl acetate) in dichloroethylene. One coated paper sheet is imaged with dithiooxamide vapors transferred from an imaged master. The coated and imaged paper is then placed in face-to-face contact with the second non-imaged but similarly coated paper sheet. After storage under conditions substantially identical to that set forth in Example X, the coated but non-imaged paper is examined. No image is found.

Example XIV

Two non-imaged nickel sulphate treated paper sheets are coated with a solution of 5% polyvinyl chloride (Escambia 1250) in methyl ethyl ketone. One coated paper sheet is imaged with dithiooxamide vapors transferred from an imaged master. The coated and imaged paper is then placed in face-to-face contact with the second non-imaged, but similarly coated paper sheet. After storage under conditions substantially identical to that set forth in Example X. the coated but non-imaged paper is examined. No image is found.

Example XV

Two non-imaged nicked sulphate treated paper sheets are coated with a solution of 15% polyvinylidene chloride (Saran F–220) and 7% acetamide (a normally solid plasticizer) in methyl ethyl ketone. One coated paper sheet is imaged with dithiooxamide vapors transferred from an imaged master. The coated and imaged paper is then placed in face-to-face contact with the second non-imaged but similarly coated paper sheet. After storage under conditions substantially identical to that set forth in Example X the coated but non-imaged paper is examined. No image is found.

Example XVI

Two non-imaged nickel-sulphate treated paper sheets are coated with a solution of 10% polyvinyl chloride resin

and 4% diphenyl phthalate (a normally solid plasticizer) in methyl ethyl ketone. The coated paper is imaged with dithiooxamide vapor transferred from an imaged master. One coated and imaged paper is then placed in face-to-face contact with the second non-imaged, but similarly coated paper sheet. After storage under conditions substantially identical to those set forth in Example X, the coated but non-imaged paper is examined. No image is found.

Example XVII

Two non-imaged silver behanate treated paper sheets are coated with a solution of 15% polyvinylidene chloride (Saran F–220) and 7% acetamide (a normally solid plasticizer) in methyl ethyl ketone. One coated paper is imaged with pyrocatechol vapors transferred from an imaged master. The coated and imaged paper is then placed in face-to-face contact with the second non-imaged, but similarly coated paper sheet. After storage under conditions substantially identical to that set forth in Example X, the coated but non-imaged paper is examined. No image is found.

The expression "thermosealing barrier layer" as employed herein is intended to include a layer of thermoplastic or thermosetting material which is porous to Chemical A at at least about the vaporization temperature of Chemical A and which is sealable after passage of Chemical A therethrough by proper control of the heat energy applied to the layer.

Although specific materials and conditions are set forth in the foregoing examples, these are merely intended as illustrations of the present invention. Various other suitable thermosealing barrier layers, base elements, plasticizers, color-forming co-reactants (i.e., Chemical A and Chemical B) and imaging processes such as those listed above may be substituted for those in the examples with similar results. Other materials may also be added to the base element, thermosealing barrier layers, plasticizer or color-forming co-reactants to sensitize, synergize or otherwise improve the thermosealing properties of other desirable properties of the system.

Other modifications of the present invention will occur to those skilled in the art upon a reading of the present disclosure. These are intended to be included within the scope of this invention.

What is claimed is:

1. A vapor thermography recording member comprising a substrate, a first reagent which reacts with a heat volatilizable second reagent to form an intensely colored product, said first reagent being available at a first surface of said substrate and a thermosealing barrier layer over said first reagent on said first surface, said thermosealing barrier layer being permeable to the vapors of said second reagent at at least about the vaporization temperature of said second reagent, said barrier layer being impermeable to said vapors after heating.

2. A vapor thermography recording member according to claim 1 wherein said thermosealing barrier layer is initially porous at room temperature.

3. A vapor thermography recording member according to claim 2 wherein said thermosealing barrier layer comprises finely divided sintered thermoplastic particles.

4. A vapor thermography recording member according to claim 1 wherein said thermosealing barrier layer consists essentially of a thermoplastic resin and solid plasticizer.

5. A vapor thermography recording member according to claim 1 wherein said thermosealing barrier layer initially consists essentially of a thermosetting resin, partially cured to a thermoplastic stage.

6. A vapor thermography recording member according to claim 1 wherein a vapor impermeable layer overlies a second surface of said substrate opposite said first surface.

7. A vapor thermography recording member according to claim 1 wherein said first reagent is also available at

a second surface of said substrate opposite said first surface and a second thermosealing barrier layer overlies said second surface.

8. A vapor thermography recording process comprising:

(a) applying visible intelligence to an original sheet with colored material containing a transferable heat volatilizable color reactive reagent;

(b) positioning said original sheet in contact with a master member;

(c) transferring at least a portion of said volatilizable color reactive reagent to the surface of said master member in contact with said original sheet;

(d) separating said original from said master sheet;

(e) positioning a thermosealing barrier layer of a vapor thermography recording member in contact with said surface of said master sheet, said thermography recording member comprising a substrate treated with a color reaction partner for said volatilizable color reactive reagent and overcoated with said thermosealing barrier layer, said layer being permeable by vapors of said reagent at the volatilization temperature thereof; and

(f) applying heat energy to said master sheet and said thermosealing barrier layer to evaporate and transfer at least a portion of said transferable heat volatilizable color reactive reagent from said surface of said master through said thermosealing barrier layer to said color reaction partner on said substrate thereby forming an intensely colored reaction product and rendering said thermosealing barrier layer impermeable to vapors of said volatilizable reagent.

9. A vapor thermography recording process according to claim 8 further including increasing said heat energy subsequent to formation of said intensely colored reaction product to render said thermosealing barrier layer impermeable to vapors of said volatilizable reagent.

10. A vapor thermography recording process according to claim 8 further including removing said heat energy subsequent to formation of said intensely colored reaction product to render said thermosealing barrier layer impermeable to vapors of said volatilizable reagent.

11. A vapor thermography recording process according to claim 8 further including maintaining application of said heat energy subsequent to formation of said intensely colored reaction product to render said thermosealing barrier layer impermeable to vapors of said volatilizable reagent.

12. A vapor thermography recording process according to claim 8 further including repeating steps (e) and (f) so as to form a plurality of duplicates.

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