

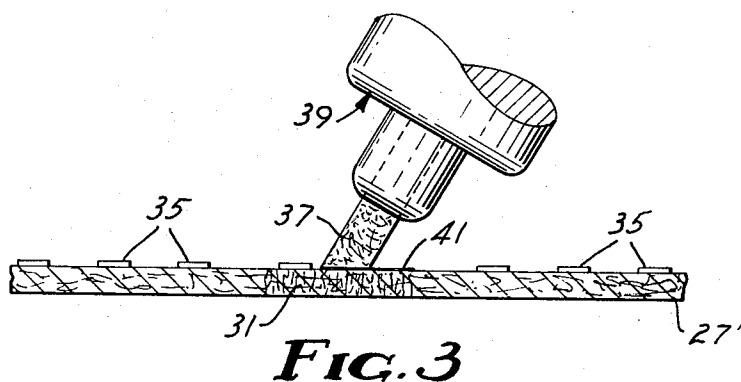
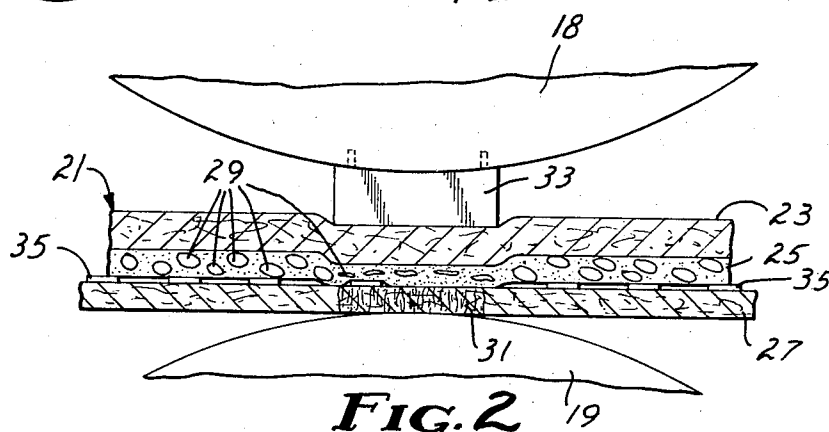
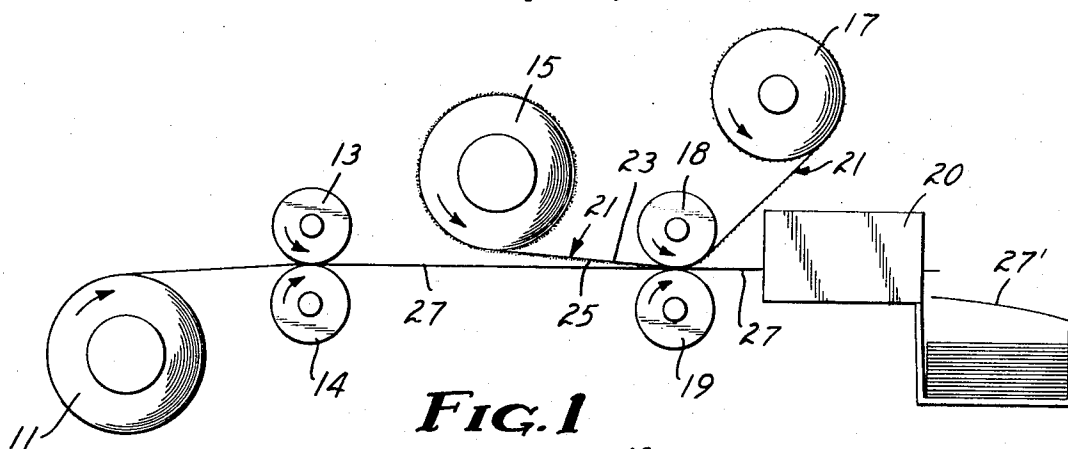
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LATENT IMAGING OR HIDDEN ENTRY SYSTEM

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LATENT IMAGING OR HIDDEN ENTRY SYSTEM
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ABSTRACT OF THE DISCLOSURE

This method of providing a paper-based feedback system involves printing visible entries on a receptor sheet; juxtaposing a coated sheet upon the printed surface of the receptor sheet, the coating comprising a microencapsulated dye precursor; crash imprinting the juxtaposed sheets such that the receptor sheet receives a latent image comprising the dye precursor; and developing the latent image with a coreactant for the dye precursor.

This invention concerns latent imaging, i.e. hidden entry systems. An aspect of this invention is that it provides a paper-based feedback system wherein hidden entries comprising a dye precursor, i.e. a reactant material capable of forming a colored complex with a coreactant, can be developed by means of a coreactant metal salt capable of forming a visible colored complex with this reactant material. A further aspect of this invention is that the hidden entry is provided on, e.g. ordinary untreated bond paper, by crushing microcapsules containing the reactant material in solution. In short, this invention involves the application of pressure-sensitive imaging technology to paper-based feedback systems for educational, amusement, or record keeping purposes or the like.

Most of the development in the field of hidden entry printing has centered around educational applications. Various training and testing procedures, particularly the more complex ones, require feedback systems. "Feedback" has been defined as "information transfer from the instructional material to the student after a response is made by the student"; see p. 1 of a report sponsored by The Southwest Regional Laboratory for Educational Research & Development (the SWRL), by Joel Strandberg, Ed. D., entitled "Feedback Systems for Use With Paper-Based Instructional Products," dated Feb. 14, 1969. "Paper-based" feedback products are, generally speaking, receptor or copy sheets, card, or the like, containing hidden information which can be chemically or physically revealed. As compared to mechanical or electrical visual devices such as teaching machines, paper-based products are economical and relatively simple to manufacture and use. Some paper-based products are limited to imparting "true/false" or "yes/no" feedback and hereinafter are said to have "coded feedback capability"; others can feed back detailed information, thereby stimulating high levels of reasoning leading to a subsequent response, and hereinafter are said to have "latent image feedback capability." In the former systems, only a color code or a property of the ink or background of the receptor sheet is hidden; in the latter, an entire printed text is hidden. Needless to say, "latent image feedback capability" can be adapted to provide "coded feedback capability," but not vice versa. The prior art systems, regardless of feedback capability, are based upon mimeographing, spirit duplicating, electrostatic photocopying, or high-production printing technology. A number of difficult problems are encountered when these techniques are adapted to paper-based feedback systems, due to the stringent requirements for making such systems truly effective. Among such requirements are:

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First, the latent image or other hidden feedback should be completely beyond detection. In some prior art systems, the latent image is not entirely invisible. In other systems, the feedback is out of register with visible printed material on an examination sheet or the like. Such misregistration can provide an extraneous cue to the student as to the correctness or incorrectness of a given response.

Second, when the latent image is developed to provide feedback, the feedback should be rapidly obtained and clearly legible. In many prior art systems, this requirement is inherently difficult to meet, due to the particular imaging chemistry or the like which is employed. In other systems, this requirement can be met only at the expense of the first requirement, i.e. only by permitting the latent image to be less than totally invisible. In still other systems, the use of relatively complex equipment is needed to provide feedback, e.g. special electric contact devices or ultraviolet illumination means. Ideally, of course, the student should be able to obtain feedback more or less instantaneously by means of an inexpensive, preferably disposable device, rather than a complex device involving a power supply, a special light source, or the like.

Third, the system should be adaptable for use with examination sheets which can be produced either in large or small numbers. Some prior art systems are suitable only for large scale production, while others, employing duplicating or photocopying processes, are not economical except for small scale production. Large-scale production is extremely desirable for nation-wide and/or highly standardized tests, but lacks the flexibility required for the more frequently revised testing procedures. Small-scale production provides a highly flexible testing tool, but is uneconomical if thousands rather than hundreds of students are to be tested. The ideal system would be economical regardless of the number of persons to be tested or instructed.

Fourth, a truly feasible paper-based feedback system would involve the use of existing printing or duplicating equipment, thus avoiding the inconvenience and expense of custom building and installing special printing presses or other special apparatus.

The SWRL Report referred to previously describes a number of proposed paper-based feedback systems. Some of these systems have only a coded feedback capability, while others have, in addition, a latent image feedback capability. An example of the former type of system would be a multiple-choice test or instruction sheet in which the choices or responses are visible printed entries. The "correct" or "true" entries are provided with one latent color code, while the "incorrect" or "false" entries are provided with a different latent color code. Latent image feedback capability, on the other hand, is not limited to a true/false or any other code. When the student develops the latent image, detailed information can be revealed. For example, on an examination sheet simulating a defective electronic device, a latent textual image setting forth electrical data could be located near the visible image of each component of the simulated device.

Two systems disclosed in the SWRL report provide latent image feedback capability using, in essence, existing equipment and a very simple chemical development means. These are: The spirit duplication/chemical pen systems devised by A. B. Dick Company and a letterpress/chemical pen systems, e.g. the "Write and See" series of Appleton-Century-Croft.

As pointed out in the SWRL Report, developing the image with the chemical pen can be somewhat slow and/or can fail to produce an easily discernible image. On the other hand, when the latent image contains enough imaging material to produce a strong visible image, the latent image area may be discernible enough to provide undesirable extraneous cues to the student. In

any event, careful control over the amount of imaging chemical contained in the latent image is a very difficult problem.

It is known in the art of pressure-sensitive imaging chemistry to provide a paper-like sheet coated on one surface with a microencapsulated imaging material, and to superimpose this microcapsule-containing coating upon a receptor sheet, so that pressure applied to the surface of the top sheet will produce an image on the surface of the receptor sheet. This imaging technology, sometimes referred to as "carbonless paper" technology, has been used to produce latent images; see Bakan et al., U.S. Pat. 3,020,171, issued Feb. 6, 1962. The Bakan et al. patent suggests that a colorless or invisible mark produced by the pressing of capsules and the flow of an imaging material released therefrom to a receptor sheet can be converted to a visible colored mark by irradiation with ultraviolet light. As pointed out earlier, this is not a practical means of developing a hidden entry, insofar as educational and testing applications are concerned.

One very commonly used chemical "carbonless paper" system involves the use of dithiooxamide (hereinafter DTO) and a heavy metal salt coreactant. See, for example, Haas, U.S. Pat. 3,287,154, issued Nov. 22, 1966. This chemical system has also been used in the spirit duplicating paper-based feedback system described previously. In view of the uncertain results obtained with that feedback system, it would not be expected that the technology described in the Haas patent could be adapted to a paper-based feedback system. Unlike the spirit duplicating feedback system, wherein the DTO must remain chemically dormant on the surface of the examination or instruction sheet for hours, days, or even months, DTO released from the Haas capsules immediately comes in contact with the metal salt coreactant. Since DTO has at least some vapor pressure at room temperature and since deposits (i.e. latent images or hidden entries) derived therefrom would be expected to have poor shelf life, it would also be expected that such latent images or hidden entries would not produce legible visible images if developed weeks or months after the latent imaging step, regardless of how the latent imaging were done.

It is also known that the 1,2-dihydroxybenzene nucleus has a strong tendency to react with ferric ions to produce a colored (generally purple) chemical complex. Besides 1,2-dihydroxybenzene itself (better known as catechol), various ortho-dihydroxy aromatic compounds substituted with one or more additional OH groups and/or a COOH group, including the trihydroxy-benzene and -benzoic acid compounds such as pyrogallol, gallic acid, gallic acid esters, and derivatives of these compounds also react with coreactant ferric salts to provide colored complexes. Water-insoluble polyhydroxyaromatic compounds can be microencapsulated in the same manner as DTO or DTO derivatives.

Briefly, this invention involves the surprising discovery that when a suitable DTO-type or polyhydroxyaromatic reactant is encapsulated and then used according to this invention to provide a latent image for a paper-based feedback system, the results obtained when using this system are markedly superior to known methods of providing latent image feedback capability, particularly in terms of speed and legibility of development as well as invisibility of the latent image. In the present invention, a paper-like sheet (hereinafter referred to as a "reactant dispensing sheet") coated, preferably entirely coated, on one surface (hereinafter the "reactant dispensing surface") with the selected microencapsulated reactant (this coating being hereinafter referred to as the "reactant dispensing layer") is juxtaposed with a receptor sheet, and a pattern of pressure is applied to the other surface (hereinafter the "opposite surface") of the "reactant dispensing sheet" to crush microcapsules in selected areas of the "reactant dispensing surface," thereby transferring

the DTO-type reactant to corresponding selected areas of the receptor sheet. Preferably the receptor sheet is an untreated sheet of bond paper, but sizing can be applied to this paper. Furthermore, a coating on one or both surfaces of the receptor sheet is permissible, provided such coating is free of chemicals which will react with the selected latent-imaging reactant to produce a visible image or mark. Examples of such coatings are waxes, clays, colloidal silica, etc. The result is latent, totally invisible mark, image, or entry on the receptor sheet which can be developed at a later time by applying to the receptor sheet a suitable metal salt along with a solvent for the reactant. (The encapsulated reactant of the "reactant dispensing layer" is dissolved in the same or a similar solvent.)

It is not clearly understood why this invention produces results superior to the aforementioned spirit duplicating or letterpress systems. Although this invention is not bound by any theory, it is theorized that the "reactant dispensing sheet," since it has a controlled amount of the reactant contained on its "bottom surface layer," is capable of precisely metering the amount of latent imaging chemical transferred to the receptor sheet. Furthermore, it is still not understood how the latent images on the receptor sheet, weeks or even months later, still contain enough reactant to provide, upon development, dark legible images—yet, such clear, dark images have in fact been obtained.

According to this invention, the latent image is preferably developed by treating it with a suitable salt of a metal and an anion of an organic or inorganic acid. Suitable metals are found in Groups I-B, II-B, and VIII (first triad) of the Periodic Table, ferric salts being especially preferred for use with the polyhydroxyaromatic compounds. Such salt solutions can be dispensed from "chemical pens," crayons, transfer sheets (see U.S. Pat. 2,168,098), or the like. It is preferred that the receptor sheet be a printed form with blank spaces provided for the hidden entries. Such printed forms also known in this art, and it is a feature of this invention that the printing of the form can be synchronized with the latent imaging such that the misregistration problem referred to previously almost never arises.

A further feature of this invention is that the printing/latent imaging method described herein is adaptable to both large and small-scale production and can be carried out on existing equipment.

A better understanding of the present invention can be obtained by referring to the drawing, in which:

FIG. 1 is a schematic illustration of a continuous, high production printing process in which a receptor sheet is first printed, then provided with latent images;

FIG. 2 is a cross sectional view, greatly enlarged, showing the hidden image providing step of FIG. 1 in greater detail; and

FIG. 3 is a cross sectional view on the same scale as FIG. 2 showing the development of a latent image by means of a chemical pen.

Turning now to the drawing, the preferred method of providing a sheet of paper or the like containing both hidden and visible entries is schematically shown in FIG. 1. In FIG. 1, a supply roll 11 of ordinary bond paper is fed to a rotary printing element 13 (alternatively, a flat printing plate could be used) and a continuous sheet of bond paper 27 having printed matter thereon results. This printed paper is fed to a rotary "crash" imprinting means 18 (which could also be a flat plate) which is also fed with a continuous "reactant dispensing sheet" 21 from supply roll 15. The two paper feeds are arranged such that the bottom surface of sheet 21, which contains a microencapsulated DTO derivative, is superimposed upon the top surface of bond sheet 27. The individual bond sheets 27' emerging from the cutting station 20 contain both visible entries supplied by rotary element 13 and invisible entries supplied by rotary crash imprinting ele-

ment 18. The reactant dispensing sheet 21 emerging from the "crash" station 18 and 19 is wound onto a tape-up roll 17 for reuse in the process, but could, if desired, go to waste. The lines of print provided by the visible entry printing station (elements 13 and 14) are in register with the invisible entries provided by the crash imprinting station (elements 18 and 19), because the drive or advancing rolls 14 and 19 are carefully synchronized to provide controlled juxtaposition of sheets 21 and 27. Furthermore, elements 13 and 18 are the same size and turn at precisely the same speed, and the positioning of their printing or imprinting surfaces bears a precise, predetermined relationship, as is known in the printing art, e.g. in multicolor printing.

In FIG. 2, the latent imaging occurring at the crash imprinting station is shown in greater detail on an enlarged scale. A raised character or letter 33 on the surface of crash imprinting element 18 is shown applying pressure to the top surface 23 of sheet 21. The DOT-dispensing layer 25 is coextensive in area with the bottom surface of sheet 21 and contains the DTO-type reactant dissolved in a solvent and contained within microcapsules 29. A number of microcapsules 29 are ruptured in the area of pressure applied by character 33 and the reactant is released so that it can migrate to the bond sheet 27 and form hidden entry 31. The hidden entry 31 is in register with the previously printed visible entries 35.

The person skilled in the art will realize that it is not necessary to employ the high production process of FIG. 1, though this is preferred. For example, two runs could be made through small-scale printing or duplicating means in place of the two-station, single run method of FIG. 1. Thus, in FIG. 2, a typewriter key, stylus, pen, or pencil could be used in place of crash imprinting element 18, so that character 33 would be the raised surface of the typewriter key or the point of the stylus, pen, etc.

In FIG. 3, the hidden entry 31 provided according to the techniques illustrated in FIGS. 1 and 2 is developed or rendered visible by means of a chemical pen 39. Alternatively, a wax crayon or any other suitable applicator means could be employed; ordinarily, the applicator or dispensing means resembles a writing instrument, as does the chemical pen 39. Pen 39 resembles the usual fiber-tipped ink applicator. In this case, the fibrous tip 37 contains a solution of a metal salt co-reactant which will react with a DTO-type reactant to produce a colored complex. In FIG. 3, a visible image 41 comprising such a colored complex is formed almost instantaneously as the fiber tip 37 contacts the hidden entry 31.

Various DTO derivatives, as well as DTO itself, are suitable for use in this invention, individually or in mixtures with each other. The preferred derivatives are the N,N'-diorgano-substituted type, e.g. N,N'-dibenzyl dithiooxamide (hereinafter DBDTO) and N,N'-bis-(2-oc-tanoyloxyethyl) dithiooxamide.

As pointed out previously, the DTO or DTO derivative entrapped in the microcapsules is dissolved in a solvent. This solvent can be the same or different as the solvent used to apply the metal salt solution used to develop the latent image. Organic liquids having varying degrees of polarity and volatility can be suitable solvents. For example, highly volatile, nonpolar solvents such as liquid alkanes are operative. A preferred liquid alkane is cyclohexane. Volatile but polar organic liquids such as the halogenated hydrocarbons (e.g. chlorinated alkanes and alkenes) are also suitable. The preferred halogenated hydrocarbons are carbon tetrachloride and trichloroethylene. Less volatile, oily liquids of varying degrees of polarity are also suitable. Among these are castor oil, oleic acid, glycerine, diesters of organic diacids (e.g. diethylphthalate), mineral oil, trialkyl phosphates (e.g. tributyl phosphate), aromatic compounds (e.g. xylol), mono- and/or diesters and/or ethers of diols, low molecular weight oily polymers, and the like. Even solid, waxy organic materials can be used to contain the metal salt co-reactant for

the DTO or DTO derivative. Needless to say, various mixtures and combinations of these solvents can also be used.

It is preferred that the solvent used inside the microcapsules be different from the solvent used for the development (metal salt applying) step. The solvents preferred for use in the microcapsules are the polar, volatile compounds such as the halogenated hydrocarbons. The solvent used in the chemical pen or other writing instrument need not be as volatile as the encapsulated solvent, and can contain at least a minor amount of tributyl phosphate (hereinafter TBP) and/or oily solvents such as glycerine. Good results have, however, been obtained with volatile, low viscosity solvents such as ethanol and monoether-monoesters of glycols.

The metal salt coreactive with the DTO-type compound can have the formula $M(OCOR)_n$, wherein n is 1, 2, or 3 (preferably 2); R is a hydrocarbon radical such as an aliphatic or aromatic group; and M is a metal of Groups I-B, II-B, or VIII (first triad) of the Periodic Table. Preferred metals are nickel, cobalt, copper, and cadmium. Examples of suitable OCOR anions are stearate, acetate, hexanoate, rosinate, benzoate, etc. Inorganic salts such as the sulfates, chlorides, and nitrates are also operative.

As pointed out previously, water-insoluble polyhydroxy aromatic compounds containing a 1,2-dihydroxybenzene nucleus (with suitable additional substituents) are suitable for use as the microencapsulated reactant material of this invention. Some of these polyhydroxyaromatic compounds are water-soluble and therefore difficult to microencapsulate. The preferred polyhydroxyaromatic compounds are those which contain a hydrophobic (preferably oleophilic) substituent, e.g. a long chain acyl radical derived from a fatty acid having at least 8 and preferably at least 10 carbon atoms. An advantage of these higher acyl or higher alkanoyl substituents is that they improve or intensify the blackness of the ferric/polyhydroxyaromatic complex. Among the particularly suitable water-insoluble pyrogallol and catechol derivatives are the decanoyl, lauroyl, or myristoyl-pyrogallol and -catechol compounds wherein the alkanoyl substituent is ortho to one of the two (or three) hydroxyls. The polyhydroxyaromatic reactants do not form strongly colored complexes with, for example, nickel ion. Ferric ion, however, produces good images and is preferred for use with the polyhydroxy aromatic reactants. Both organic and inorganic salts can be used, e.g. $Fe(OCOR)_3$, wherein R is as defined previously, $FeCl_3$, $Fe(NO_3)_3$, etc. Ferric benzoate and ferric salts of fatty acids are convenient for use in crayons, transfer sheets, "Chemical pens," etc.

The preferred polyhydroxyaromatic compounds can be encapsulated in the aforementioned solvents or similar solvents, e.g. xylene, toluene, acetone, TBP or other trialkylphosphates, dialkylphthalates, and esterified and/or etherified glycols. The ferric salts can be dissolved or otherwise contained in similar media, e.g. TBP, castor oil, castor wax, esterified and/or etherified glycols, synthetic organic polymeric resins, dialkylphthalates, etc.

The principles of this invention find application outside the area of paper-based feedback systems. For example, it is desirable to provide latent images or hidden entries for use in toys, games confidential record-keeping systems, and other paper-based materials requiring the use of invisible latent, or hidden entries. Generally, the terms "hidden," "invisible," and "latent" are used synonymously in this application, the primary intent of this terminology being to denote an entry, mark, or image which does not contrast at all with the background and cannot be discerned by the naked eye.

The encapsulation of the solution of the DTO-type polyhydroxyaromatic reactant can be by any of the techniques known in the microencapsulation art. The preferred microcapsules are smaller than 100 microns, preferably 5-40 microns in size, and they comprise walls of urea-formaldehyde. The coating, of urea-formaldehyde capsules

containing the reactant, onto the reactant dispensing sheet also involves known techniques. Examples of a preferred technique and its use in the method of this invention will now be described. In each example, all parts are by weight unless otherwise specified.

EXAMPLE I

Part A: Encapsulation of DBDTO/trichloroethylene solution

Into 7700 parts by weight of water was introduced 4900 parts of a water soluble precondensate of urea and formaldehyde in about 1:2 molar ratio composed predominantly of di-methylol urea formaldehyde; 1340 parts of a 10% (by weight) solution of NaCl was then added to reduce the solubility of the fill liquid. Next 3300 parts of organic fill liquid, immiscible in the aqueous solution and consisting of 2.5% (by weight) $\text{Cl}_2\text{C}=\text{CHCl}$ solution of N,N'-dibenzylthiooxamide (DBDTO), were added, and the resultant mixture agitated with turbine blades revolving at 2200 r.p.m. to maintain the

DBDTO/ $\text{Cl}_2\text{C}=\text{CHCl}$

filled liquid as small discrete droplets in the aqueous solution. Then 30 parts 3 N hydrochloric acid were added, in three 10-part increments, the time for all three acid addition steps totaling 70 minutes. All of the foregoing steps were carried out at approximately 70° F. (20° C.). After the last increment of acid was added, the temperature was raised to 105° F. (41° C.) and the urea-formaldehyde polymerization reaction was allowed to proceed at that temperature for approximately 8 hours. Then the bath was neutralized. The resulting urea-formaldehyde capsules were insoluble in water, averaged 5 to 25 microns in size, and consisted of approximately 40% by weight DBDTO/ $\text{Cl}_2\text{C}=\text{CHCl}$ liquid fill.

Part B: Reactant-dispensing sheet

A DBDTO-dispensing (capsule coated) sheet is made by taking enough of the capsule slurry produced in Part A to provide 55 parts, on a dry, by-product-free basis, of capsules and mixing this slurry with 33 parts of starch and 12 parts of aqueous poly(butadiene-styrene) latex. The resulting mixture was air knife coated to produce a uniform thickness layer on a paper web. The resulting coated paper is dried with hot forced air at 180° F. (82° C.), to produce a layer or coating having a dry weight of 7 lb./140 sq. yd. (27 g./m.²), and wound into roll form.

Part C: Printing and latent imaging of bond paper examination sheet

The procedure illustrated in FIG. 1 was followed, the reactant dispensing sheet 21 being the paper produced according to Part B. The visible entry printing station printed a series of entries for a medical school examination question. The entries related to tests for objective signs (e.g. urinalysis) and proposed treatments for various diseases, e.g. diabetes and heart failure. Each visible entry was followed by a blank space. The crash imprinting station provided an invisible text consisting of a list of the objective signs observed in a hypothetical patient, corresponding to the preprinted tests (e.g. "sugar 4-plus, acetone 4-plus"), as well as the responses of the hypothetical patient to the pre-printed proposed treatments (e.g., "patient is comatose," "patient improves," "no change"). The hidden and visible texts were arranged such that the hidden entries were provided in the aforementioned blank spaces.

Part D: Developing the hidden entries

The reservoir of the fiber-tipped pen 39 of FIG. 3 was

filled with a solution of 2 parts nickel (II) octoate in a solvent comprising a mixture of 4 parts ethyl alcohol and one part diethylene glycol monoethyl ether acetate. Several days after the examination sheet of Part C was printed and latent-imaged, the hidden entries were revealed rapidly by rubbing the fiber tip once or twice across the blank spaces. The thus-developed images were dark purple, clearly legible, and exactly in register with the lines of pre-printed material. However, prior to development, the hidden entries were not visible to the eye, even when aided with a microscope.

EXAMPLE II

A lauroyl pyrogallol/toluene solution was encapsulated as in Example I(A) to provide similar microcapsules. A coated (reactant-dispensing) sheet was made as in Example I(B), and was cut to half of letter size, i.e. 4¼ x 11 inches (about 11 x 28 cm.). The reactant dispensing sheet was placed over the right half of a letter size sheet of bond paper, 8½ x 11 inches in size, and the juxtaposed sheets were inserted in a typewriter. Questions were typed on the uncovered left half of the bond sheet, producing visible entries, and answers were typed on the reactant dispensing sheet, producing completely invisible latent entries on the right half of the bond sheet. A chemical pen containing a solution of ferric benzoate in TBP was used to develop the latent answer entries. Black, legible images were obtained.

What is claimed is:

1. A method of providing and developing latent images on a receptor sheet also containing visible entries, said method comprising:

(1) introducing visible entries onto selected portions of a surface of said receptor sheet, said receptor sheet having, in addition to said selected portions, blank portions, said blank portions being free of materials capable of forming a visible, colored complex by reaction with a reactant selected from the group consisting of dithiooxamide, derivatives of dithiooxamide, and a water-insoluble polyhydroxy-substituted aromatic compound having at least two ortho-hydroxy groups;

(2) juxtaposing a reactant dispensing sheet upon the said surface of the said receptor sheet such that the reactant dispensing surface of said reactant dispensing sheet is in contact with said visibly-imaged surface, said reactant dispensing surface having a layer thereon comprising a microencapsulated solution containing a said reactant selected from said group;

(3) applying a pattern of pressure to the opposite surface of the said reactant dispensing sheet, said pattern corresponding to the desired latent images and said pressure being sufficient to crush the microcapsules microencapsulating said solution, containing said reactant, thus permitting said solution containing said reactant to migrate to said blank portions of said visibly-imaged surface and to form said latent images thereon; and

(4) rendering said latent images visible by applying thereto a metal salt coreactant capable of forming a visible colored chemical complex with said reactant.

2. A method according to claim 1 wherein said reactant is selected from the group consisting of dithiooxamide, and N,N'-di-organo-substituted derivative of dithiooxamide, ortho-(higher alkanoyl)-pyrogallol, and ortho-(higher alkanoyl)-catechol.

3. A method according to claim 2 wherein said derivative is selected from the group consisting of N,N'-dibenzyl dithiooxamide, N,N'-bis-(2-octanoyloxyethyl) dithiooxamide, and mixtures thereof, and the metal of said metal salt is selected from nickel, copper, cadmium, and cobalt.

4. A method according to claim 2 wherein said reactant is ortho-(higher alkanoyl)-pyrogallol and said metal salt is a ferric salt.

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5. A method according to claim 1 wherein said receptor sheet is untreated bond paper.

6. A method according to claim 1 wherein steps (1), (2), and (3) are synchronized such that said visible entries and said latent images will be in register, and wherein said pattern of pressure is applied with a crash imprinting means.

7. A method according to claim 1 wherein said reactant is encapsulated within capsules 5-40 microns in size, said capsules having walls of urea-formaldehyde polymer.

8. A method according to claim 1 wherein the solvent of said microencapsulated solution consists essentially of a volatile organic liquid having substantially greater volatility than glycerin.

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