(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 149 784**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **84115108.7**

(22) Date of filing: **10.12.84**

(51) Int. Cl.⁴: **G 09 F 3/02**
B 41 M 5/26

(30) Priority: **16.01.84 US 571295**

(43) Date of publication of application:
31.07.85 Bulletin 85/31

(84) Designated Contracting States:
CH DE FR GB LI NL SE

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(54) Process for transferring color-changing coating uniformly onto indicator and transfer ribbon therefore.

(57) A color-changing coating is transferred by pressure in a coating station from a transfer ribbon onto a selected region of an indicator. The continuous coated ribbon and a continuous length of indicators are each conveyed through the coating station, generally in a parallel direction. Pressure may be applied by rollers forming transferred shapes of coating such as bars extending in the direction of conveyance. The color changing coating may contain a component such as a compound with conjugated acetylenic bonds which changes color as a cumulative measurement of temperature exposure.

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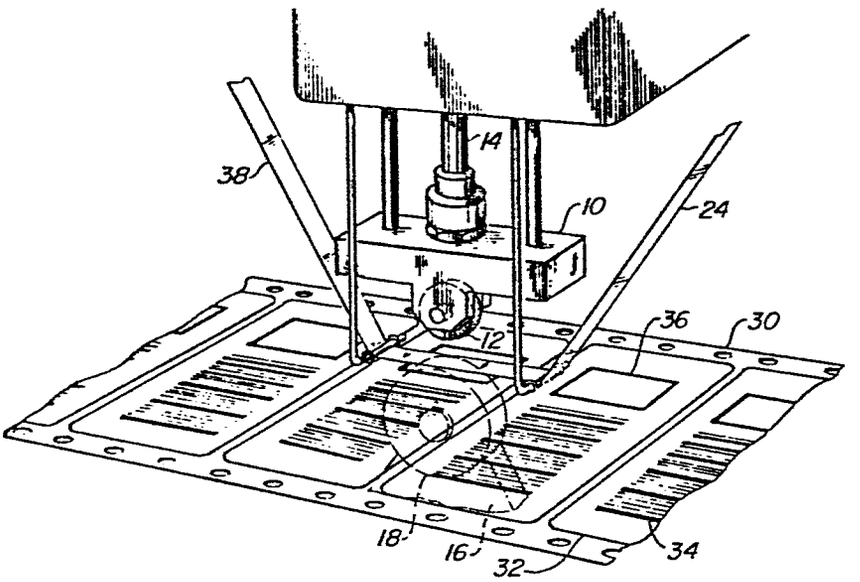
FIG-2



DESCRIPTION

PROCESS FOR TRANSFERRING COLOR-CHANGING COATING UNIFORMLY ONTO INDICATOR AND TRANSFER RIBBON THEREFORE

BACKGROUND OF THE INVENTION

The present invention relates to a transfer process, and especially a process for transferring a color-changing coating uniformly onto an indicator especially in the shape a bar which develops color uniformly upon certain exposure of the indicator.

Transfer printing, particularly in printing of waxy compositions containing a pigment such as carbon black, have been used previously in a variety of settings. In general, such ribbon processes have been concerned with providing a ribbon containing a continuous coating of a pigmented formulation on one side, with the ribbon being struck on the opposite side by a typeface or other shaped object so as to transfer a shaped coating such as an alphanumeric character onto a substrate such as paper. Only gross uniformity of the coating transferred is required in such applications.

Printing formulations, and especially inks, have been applied to paper in a variety of applications wherein subsequent environmental factors or manipulations of the printed paper cause color change. Such changes occurred in the area of security printing (wherein a latent image is printed to be developed only under certain environmental exposure conditions) and in applications wherein a single gross color change is required to indicate that an event has occurred (as in U.S. Patent 4,180,204 to Koenig et al. (December 25, 1979)). In such applications it is again not critical that the color developed have a high degree of uniformity either within a single imprint or between successive imprints.

Formulations containing diacetylene compounds (and other acetylenic compositions) have been disclosed for the indication of cumulative-temperature exposure or radiation exposure in a series of patents including U.S.

Patent No. 3,999,946 to Patel et al (1976); 4,189,399 to Patel (1980); 4,389,217 to Baughman et al (1983); and 4,208,186 to Patel (1980).

In the issued versions of these disclosures, a gradation in color formation is indicated as having significance; however such gradations are based on visual observations and, therefore, it is unlikely that variations less than 10 percent in reflectivity would have significance. See U.S. Patent 4,189,399, Figure 4. In U.S. Patent Applications Serial No. 469,880 of Prusik et al (filed February 25, 1983, copending and commonly assigned), the reading of indicators containing such acetylenic compounds is disclosed employing differential reflectance measurements having a much higher degree of sensitivity. In such a system, reflectance differences as little as 1 or 2 percent are measured and correlated to different levels of cumulative thermal exposure or other cumulative environmental exposure. Accordingly, for such a system, the ability to provide indicators with a highly reproducible and uniform color formation is highly desirable. Furthermore, for acetylenic compounds and most other color changing compositions, it should be apparent that uniformity in the coating layer is likely to be a necessary condition for uniformity in color formation (as measured by reflectance). A variety of techniques have been employed to print uniform bars and other structures on paper for the indicators of U.S. Serial No. 469,880. Such techniques have involved a variety of inks containing the solvent in which the acetylenic compound is dispersed, along with other ingredients. See U.S. Patent 4,215,208 of Yee et al (1980); European Patent Application 47,918 of Allied Corporation (March 24, 1982); U.S. Patent 3,501,297 of Cremeans (1970).

BRIEF DESCRIPTION OF THE INVENTION

It has been discovered that extremely uniform color-changing coatings can be applied in bars or other shapes onto indicators, so as to give a highly repro-

ducible and uniform reading in the method of application Serial No. 469,880. Using a transfer process, uniform coatings of a variety of shapes can be applied using a variety of color-changing compositions and especially acetylenic color-changing compositions. Accordingly, the present invention includes a process of applying a uniform color-changing coating onto a selected region of a plurality of indicators which comprises the steps:

(a) conveying a continuous length of planar indicators through a first controlled position in a coating station,

(b) conveying a continuous length of uniformly coated planar ribbon through a second controlled position in said coating station substantially parallel to an indicator in said first control position, said ribbon comprising a backing and a uniform releasable coating on the side of said backing adjacent to said indicator in said coating station, and

(c) applying sufficient pressure to a selected portion of said backing on the side opposite said releasable coating to transfer said releasable coating to an adjacent selective portion of the indicator in said coating station;

said coating containing a component exhibiting reproducible color change dependant upon environmental exposure of the coating on an indicator.

Especially preferred forms of the invention include those in which both the continuous length of indicators and the continuous length of uniformly coated ribbon travel at constant velocity through the coating station, and pressure is applied by a roller or stylus over which the continuous length of coated ribbon travels. Such a method is particularly suited for transferring coating in the shape of a bar extending in a direction parallel to the direction of movement of the ribbon, which is generally also parallel to the direction of movement of the indicators.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is an elevational view of an apparatus for practicing a first mode of the process of the present invention, employing a roller to apply pressure to a ribbon (shown) to transfer a coating to a series of labels (not shown);

Figure 2 is a view similar to Figure 1 showing a plurality of labels conveyed into position for printing, but with the roller still retracted;

Figure 3 is a view similar to Figure 2 in which the roller is applying pressure to transfer coating onto an indicator;

Figure 4 is a plan view along the ribbon in Figure 3 showing the coating prior to transfer on the right, and the residual coating after transfer on the left;

Figure 5 is a view similar to Figure 4 of a somewhat modified ribbon, in which the coating is wider than the smaller roller;

Figure 6 is a view similar to Figures 4 and 5 of a ribbon used in a second form of the invention in which the path of travel of the roller is perpendicular to, rather than parallel with the path of travel of the ribbon.

Figure 7 is a plan view of a first form of indicator printed by the process of the invention.

Figure 8 is a plan view of a second form indicator printed by the process of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention can be described by first considering the illustrative embodiments of the drawing and then considering various materials, alternatives and broader forms of the present invention. Figure 1 illustrates an apparatus used in the process of the present invention, as described more fully below in connection with Figures 1, 2 and 3. In Figure 1, a moveable block 10 has rotatably mounted thereon a top idler roller 12 presenting an annular surface which is open to contact at the bottom and is free to rotate around an axis

extending horizontally in approximately the direction of the view. The block 10 is mounted on a series of guide bars and a drive shaft 14 to an air cylinder assembly or other controllable motive means so as to lower the entire block 10 and thereby the annular surface of top idler roller 12. A stationary lower block 16 is fixedly positioned below the top block 10 and has rotatably mounted on it a bottom idler roller 18 presenting an annular surface which rotates about an axis parallel to the axis of top idler roller 12. The two idler rollers are positioned so that, when the block 10 is fully lowered, the annular surfaces of the two rollers are nearly in contact, and the spacing there- between at the point of nearest approach is a slot of uniform height extending parallel to the two axes of rotation. Fixedly mounted left and right of this slot are guide bars 20 and 22 (shown as being mounted to the air cylinder assembly but optionally mounted to any other fixed part of the structure) extending parallel to the axes of rotation of top idler roller 12 and bottom idler roller 18, with a plane between guide bars 20 and 22 extending through or slightly above the slot formed between the two rollers when the block 10 is fully lowered. A ribbon is shown with the incoming ribbon 24 passing downwardly and toward guide bar 20, across and immediately below guide bar 20, through the slot to guide bar 22, below and across guidebar 22 and continuing to the left upward as used ribbon 38. To permit free movement of the ribbon over guidebars 20 and 22, the guidebars 20 and 22 may also be freely rotatable.

Referring to Figure 2, elements 10-38 correspond to elements bearing the same numerals in Figure 1. A planar label stock 30 is shown passing from right to left below guidebars 20 and 22 and above bottom idler roller 18. The label stock has fixed to its upper side a series of labels 32 imprinted with a bar code 34 and a reference rectangle 36. The label stock is aligned such that the rectangle 36 passes through the slot between

guide rollers 12 and 18 below the ribbon 24. The label stock is moved from right to left at uniform velocity by means such as rotating pins, a take-up roller or tenters (not shown). Each guide rectangle 36 passes through a printing station (slot) between the two idler rollers and immediately below the ribbon 24.

Referring now to Figure 3, the moveable block 10 has been lowered so as to contact the top idler roller 12 against the ribbon 24 immediately adjacent to the reference rectangle 36 of a particular label 32c. This contact is sufficient to apply a uniform pressure between the two guide rollers such that the movement of the ribbon 24 and the label 32c causes each idler roller to rotate (the top idler roller 12 to rotate clockwise and the bottom idler roller 18 to rotate counterclockwise). While the moveable block 10 is in this lowered position, the ribbon is pulled at a uniform velocity, which, in general, would correspond to the velocity of the label stock 30. The velocity of the ribbon can be controlled either by a take-up roller matched to the take up of label stock or, more preferably, by having the ribbon propelled by the label stock when the two are pressed together between the rollers. Comparing the appearance of reference rectangles 36 of labels 32a and 32b which have passed through the printing station with the reference rectangles 36 of labels 32d, 32e and 32f which have not, it can be seen that a line or bar of width smaller than the interior of the rectangle has been transferred by the action of the idler rollers 12 and 18 on each label which has passed through the printing station.

In order to conserve transfer material, it is advantageous that the ribbon 24 moves across guidebars 20 and 22 essentially only when the moveable block 10 is lowered, and furthermore that such occur only when a reference rectangle 36 is in the slot between the two guide rollers. Such conditions can be controlled either by a repetitive timing cycle controlled electrically or

mechanically, or by a sensor which recognizes the entrance of a rectangle into the slot (or its positioning a fixed distance to the right of the slot) and causes the moveable block 10 to be lowered and the ribbon to be moved only when such occurs.

Referring to Figure 4, the outcome of such control can be seen: with the ribbon 24 which has not yet passed through the slot having a continuous bar of coating; and the ribbon 38 which has passed through the slot having a series of elongated spaces 38a from which the coating has been transferred, between which are a series of small strips 38b where coating remains. It is generally desirable that small strips 38b remain so that any nonuniformity in completing the coating on one indicator does not cause a nonuniform initiation of coating on the next indicator. It is not, however, usually necessary to continue the movement of the ribbon after the moveable block has been retracted upward, since a very small length of ribbon is available for retraction or movement merely by releasing the ribbon from pressure as the moveable block 10 is retracted upward. So long as this slack is retracted in a forward (leftward) direction rather than pulled back (rightward), it is generally sufficient to create the strips 38b of remaining coating. In some preferred forms of the invention, the take-up of ribbon is by a relatively high speed, low torque motor driving a spool to take up the ribbon slack when the block is lowered and is first retracted.

Referring to Figure 4, it can be seen that a uniform continuous coating can be fed into the process and a series of bars of the same width as the uniform coating can be transferred. Provided that the controlled width is maintained in fabricating the ribbon 24, the two idler rollers 12 and 18 can be the same or greater in width and still achieve the same effect. It is contemplated, however, that a greater accuracy in bar width may be desired and/or that a single ribbon may be desired to be used flexibly for creating bars of dif-

ferent widths. In such event, the width of at least one of the idler rollers (which can be interchanged when different widths are desired) should correspond precisely to the width of bar desired (with the other idler roller being the same width or greater in width) and the width of the coating on the ribbon can then be larger. It is generally preferred that the roller contacting the label stock (the lower roller 18 in Figures 1-3) be of greater width and that the roller contacting the back of the ribbon (the upper roller 12 in Figures 1-3) be of lesser width and thus control the width of coating transferred. Compared to this controlling width, the width of coating can be of equal or lesser width (producing the configuration of coating on outgoing ribbon 38 in Figure 4) or can be wider. If the coating is wider, as in the embodiments illustrated in Figure 5, the incoming ribbon 124 has a coating of greater width than the areas 138a (from which coating has been transferred in the outgoing ribbon 138) such that the remaining regions 138b contain somewhat more material (and are shaped like a rectangular chain) compared to the isolated remaining strips 38b illustrated in Figure 4.

It should also be appreciated that in Figures 1 through 3 the path of travel of the roller is parallel to the path of travel of both the ribbon and the labels. In such event, it is not necessary to interrupt the movement of the indicators during coating transfer. In some cases, however, it may be desirable to convey the indicators in discontinuous fashion, stopping movement when an indicator is in a coating station and then applying pressure to the adjacent ribbon with a driven roller that transfers a bar or other shape of coating onto the indicator. In such event, the roller may travel either parallel to, perpendicular to or at some angle to the path of travel of the indicators. Figure 6 illustrates a ribbon from which bars have been transferred in a direction perpendicular to the path of

travel of the ribbon (which may be either parallel to or perpendicular to the path of travel of the indicators). Such a geometry permits the use of a wider coating (being in the long direction of the bars) and minimizes the length of ribbon used. This geometry is less preferred, however, compared to the embodiments illustrated in Figures 4 and 5, because of the requirement of discontinuity in the motion of the indicators.

The process of the present invention can be practiced with a variety of modifications in the apparatus indicated in Figures 1-3. Thus, for example, the lower rather than the upper roller could be retracted or the entire geometry could be turned upside down. Furthermore, either or both idler rollers could be driven. In addition, one could apply a stylus or other fixed surface on moveable block 10 and/or provide a planar or other fixed surface below the stock 30 attached to stationary lower block 16. In general, however, it is believed that two rollers provide the possibility of a greater degree of uniformity in pressure. Furthermore, it is contemplated that, rather than providing a bar of uniform width through use of either a uniform coating on the tape 24 or a uniform width of the two idler rollers, a different shape can be created merely by modifying the circumferential surface of one or both idler rollers. It is also contemplated to substitute a planar surface for one roller and a shaped surface (e.g., a type face) to the other.

It is also contemplated that more than one bar or other area of coating may be applied simultaneously, such as by employing a series of pairs of rollers through which the indicators pass simultaneously (arranged either next to each other so as to coat the same indicator simultaneously or in line so as to coat different parts of an indicator sequentially). With parallel pairs of rollers, the coating may be transferred from parallel multiple bars of coating on a single ribbon or from a single continuous bar of coating

on each of two or more ribbons, each continuous bar of coating passing between rollers of a pair. With sequential pairs of rollers, a controlled exposure step may be used between transfer steps to impart a controlled degree of exposure (generally radiation exposure) to the first-printed bars to achieve the effect set forth in U.S. Patent 4,389,217, or activation (generally by a chemical reagent such as an acid as described in columns 9-11 of U.S. Patent 4,373,032, to Preziosi et al. (1983)). It is also further contemplated that the coating operation between the idler rollers could be in line with the printing of the bar code 34, the coating over the reference rectangle 36 bearing the coated strip of a protective layer (such as an ultraviolet ray absorbing layer) or the printing of additional information onto the label. Such additional printing may, for example, designate the specific case number of a carton to be labeled (while the existing bars are uniform from label to label, this additional bar coding would be sequential).

Figure 7 illustrates a label 232 coated by two such pairs of roller. The label 232 contains a product identification bar code 233 (corresponding in machine readable form to the "9000" in human readable form), a first indicator identifier 234 (corresponding in machine readable form to the "10") and a second indicator identifier 235 (corresponding in machine readable form to the "24"). The reference element 236 is printed as a rectangle with a central vertical stripe so as to form three vertical reference bars. By the present process, two coating stripes 237a and 237b are transferred so as to be measured for reflectance versus adjacent reference bars and unprinted areas by the method of U.S.S.N. 469,880, with indicator identifiers 234 and 235 corresponding to the materials (or levels of preexposure) of the indicator coatings 237a and 237b.

Figure 8 illustrates a simpler indicator label which can be prepared by the present process, with the

coating stripe 137 positioned centrally between preprinted reference bars 136a and 136b. In some indicators of this and the other configurations, it may be desirable to coat the entire indicator (or at least the portion bearing coating stripe 37, 137a or 237a and 237b) with a protective coating, and especially one which absorbs ultraviolet light.

The coating present on the tape 24 can contain any of the acetylenic materials indicated in above-referenced U.S. Patents 4,189,399, 4,389,217, 4,208,186 or in U.S. Patent 4,242,440 (especially for monitoring radiation exposure) or in copending, commonly-assigned Serial No. 514,399 of Preziosi et. al., filed July 18, 1983 (especially diureadiynes). Such acetylenic materials can be formulated with various waxes or other materials in a manner similar to the formulation of pigments into transfer coatings in U.S. Patents 3,825,470 to Elbert et al (1974) and 3,825,437 to Blair (1974). Exemplary formulations are given in the present examples.

Furthermore, other materials which change color in response to environmental exposure can be included in the coated formulation. Examples include spiropyrans and various materials known to respond to radiation such as hexahydroxyethylaminotriphenylnitrile. In addition, it may be desired in some cases to include a small amount of a pigment in the coating formulation so as to have a visible color (preferably not effective at the wavelength in which reflectance is to be measured for the variable material) so as to readily identify labels onto which the coating has been applied. Other suitable and alternative features of the labels are described in U.S. Serial No. 469,880, referred to above, the disclosure of which is incorporated herein by reference.

In preparing the ribbon, a composition is generally applied to the backing which composition includes all of the ingredients of the final coating plus a volatile solvent or volatile solvent mixture. Such solvent or

solvent mixture is evaporated off before the ribbon is used in the present transfer process. This procedure differs from printing with ink formulations which themselves contain a volatile solvent in several respects. First, no solvent evaporation occurs in the area of the printing operation, but instead occurs where ribbon is made, generally an easier environment to control. Second, in a label distribution arrangement, transfer can occur later, such as immediately before placement on cartons or the like. Ribbon is generally more compact than labels and therefore easier to store in a controlled environment, especially very low temperature for rapidly polymizing acetylenic compounds used to monitor cumulative temperature exposure of very perishable products such as chilled or frozen foods. Finally, the temperature exposure and possible variations among labels therein during solvent evaporation from indicators is eliminated. Temperature exposure during solvent evaporation from the more compact ribbon is easier to make uniform and can, if desired, cause an intentional controlled degree of partial polymization (see U.S. Patent 4,389,217 for indicators with two bars of acadetylenic compound, one partially polymized).

EXAMPLES

The color-changing compound N,N"-1,6-hexa-2,4-diyne diyl-bis(N'-ethylurea) having the formula $[CH_3CH_2NHC(O)NHCH_2C{\equiv}C\frac{}{}_2$, prepared as indicated in pending application S.N. 514,399 of Preziosi et al. (incorporated herein by reference) was ground to particles of less than one micrometer (micron) diameter and formulated as a pigment into an ink as follows:

Diureadiyne	8.4% (by weight)
Resin*	22.5%
Ascorbic acid	2.2%
Toluene	11.3%
Isopropanol	33.3%
Rapeseed oil	17.9%
Mineral oil	4.4%

*Polyamide resin sold by Union Camp under the UNIREZ 2931 trademark.

The ink was coated onto a continuous polyethylene film of 0.00075 inch (19.1 μm) thickness and 5/16 inch (8 mm) width at a wet coating thickness of 0.0012 to 0.0013 inch (30-33 μm). After drying under ambient conditions for about three minutes, the coating had a dry coating thickness 0.0006-0.0007 inch (15-18 μm). It is believed that toluene and isopropanol, but not the other components, evaporated during drying of the ribbon.

A label stock was used known as "pinfeed pressure sensitive label stock". It contained a fanfolded paper backing sheet of 4-3/4 inch (12 cm) width onto which was mounted a series of labels, each 4 inches (10 cm) in length and 1-7/16 inch (3.6 cm) in width onto which had been printed a bar code (as indicated by numeral 34 in Figure 3) and a rectangular reference bar (as indicated by numeral 36 in Figure 3). Each reference rectangle had an outside profile of 3/4 inch (19 mm) by 15/32 inch (11.9 mm) and an inside profile of 19/32 inch (15 mm) by 5/16 inch (7.9 mm) so as to contain 5/64 inch (2 mm) wide uniformly darkened strip on the top, bottom and sides.

The ribbon and label stock were conveyed through the apparatus shown in Figures 1-3 by impinging the label stock with rotating pins at a speed of 2.5 cm/min. The top roller 12 was a cylindrical ball bearing of 0.375 inch (9.5 mm) outside diameter, 0.125 inch (3.18 mm) inside diameter and 0.155 inch (3.9 mm) height of which 1/8 inch (3 mm) was cylindrical (in the direction of, but narrower than the 8 mm width of the coating strip). The bottom roller 18 was a cylindrical ball bearing of 1.125 inch (28.6 mm) outside diameter, 0.500 inch (12.7 mm) inside diameter and 0.312 inch (8 mm) cylindrical height (wider still than top roller 12).

When a rectangle was sensed a fixed distance before the slot between the rollers, the air cylinder lowered the top roller to engage the ribbon and label stock between top and bottom rollers, so that both moved at the 2.5 cm/min speed and the coating was transferred onto each label as a 1/8 inch (3 mm) wide stripe, centered within a reference rectangle, covering the entire 19/32 inch (15 mm) interior height of each rectangle. The ribbon, viewed as in Figure 5, had areas 138a of 19/32 inch (15 mm) length separated by stripes (the vertical portion of area 138b) of approximately 1/32 inch (0.8 mm) width.

The bars of coating transferred onto the labels were evaluated using a Macbeth PCM II Print Contrast Meter (manufactured by Macbeth division of Kollmorgan Corporation of Newburgh, N.Y.) to measure reflectance at 632 nm of 0.008 inch (0.20 mm) diameter spots over the entire bar. The variation between spots averaged 3% of full scale reflectance. Visually the bars were of extremely good quality, without voids and with sharp edge definition.

Alternate Formulations

Ribbons were made as in Example 1 with several ink formulations as indicated below:

	Example 1	A	B	C	D
Diureadiyne	8.4	4.4	10.4	13.1	10.5
Resin	22.5	11.8	11.0	10.2	10.1
Ascorbic Acid	2.2	1.1	1.1	0.6	1.4
Toluene	11.3	14.4	13.5	11.8	12.4
Isopropanol	33.3	57.2	53.6	49.3	49.3
Rapeseed Oil	17.9	8.9	8.3	10.5	11.5
Mineral Oil	4.4	2.2	2.1	4.5	4.8

Formulation D produced the best ribbon (as tested in a typewriter) of Formulations A-D.

It should be understood by one skilled in the art that other resins may be substituted for the polyamide resin, other volatile solvents for the toluene/isopropanol and other waxy materials for the rapeseed oil/mineral oil. Other antioxidants may be substituted for ascorbic acid and all ingredients can be optimized for proportions through routine experimentation. Fixed pigments such as silicates, amorphous silicas and fumed silicas may be added if desired. Alcohol soluble dyes can also be added to give the coating a starting color.

WHAT IS CLAIMED IS:

1. A process of applying a uniform color-changing coating onto a selected region of a plurality of indicators which comprises the steps:

(a) conveying a continuous length of planar indicators through a first controlled position in a coating station,

(b) conveying a continuous length of uniformly coated planar ribbon through a second controlled position in said coating station substantially parallel to an indicator in said first control position, said ribbon comprising a backing and a uniform releasable coating on the side of said backing adjacent to said indicator in said coating station, and

(c) applying sufficient pressure to a selected portion of said backing on the side opposite said releasable coating to transfer said releasable coating to an adjacent selected region of the indicator in said coating station;

said coating containing a component exhibiting reproducible color change dependent upon environmental exposure of the coating on an indicator.

2. The process of claim 1 wherein said continuous length of planar indicators and said continuous length of coated planar ribbon are conveyed through said coating station in substantially parallel or substantially perpendicular directions.

3. The process of claim 1 wherein said applying sufficient pressure step (c) comprises contacting the opposite side of said backing with a shaped surface which is stationary while the planar ribbon is conveyed.

4. The process of claim 1 wherein said applying sufficient pressure step (c) comprises rolling over said other surface of said backing a roller at substantially constant pressure along a path comprising the region of said backing corresponding to the adjacent selected region of the indicator.

5. The process of claim 4 wherein the continuous length of coated planar ribbon is conveyed at substantially the same velocity as said continuous length of labels.

6. The process of claim 5 wherein the continuous length of coated planar ribbon is conveyed by a force transmitted through said continuous length of planar labels.

7. The process of claim 1 wherein a plurality of continuous lengths of uniformly coated planar ribbons are each conveyed through one said coating station and pressure is applied to each of said ribbons to transfer coating to a said selected portion of an indicator.

8. The process of claim 1 wherein each said indicator comprises at least one printed reference bar of uniform reflectivity and said selected portion of the indicator is a bar adjacent to and substantially parallel with the reference bar.

9. A transfer ribbon comprising:

(a) a continuous planar backing extending in a first direction, and

(b) a continuous strip of coating releasably coated on a first planar side of said continuous planar backing, extending continuously in said first direction;

said continuous strip of coating being of uniform thickness and composition and containing a component exhibiting reproducible color change dependent upon environmental exposure.

10. The transfer ribbon of claim 9 having a plurality of said continuous strips of coating each exhibiting a different color change behavior.

FIG-1

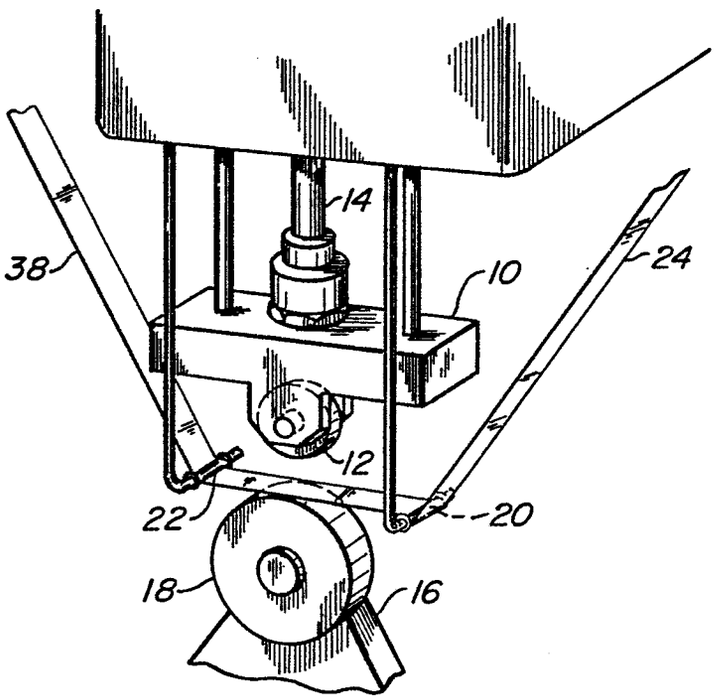


FIG-2

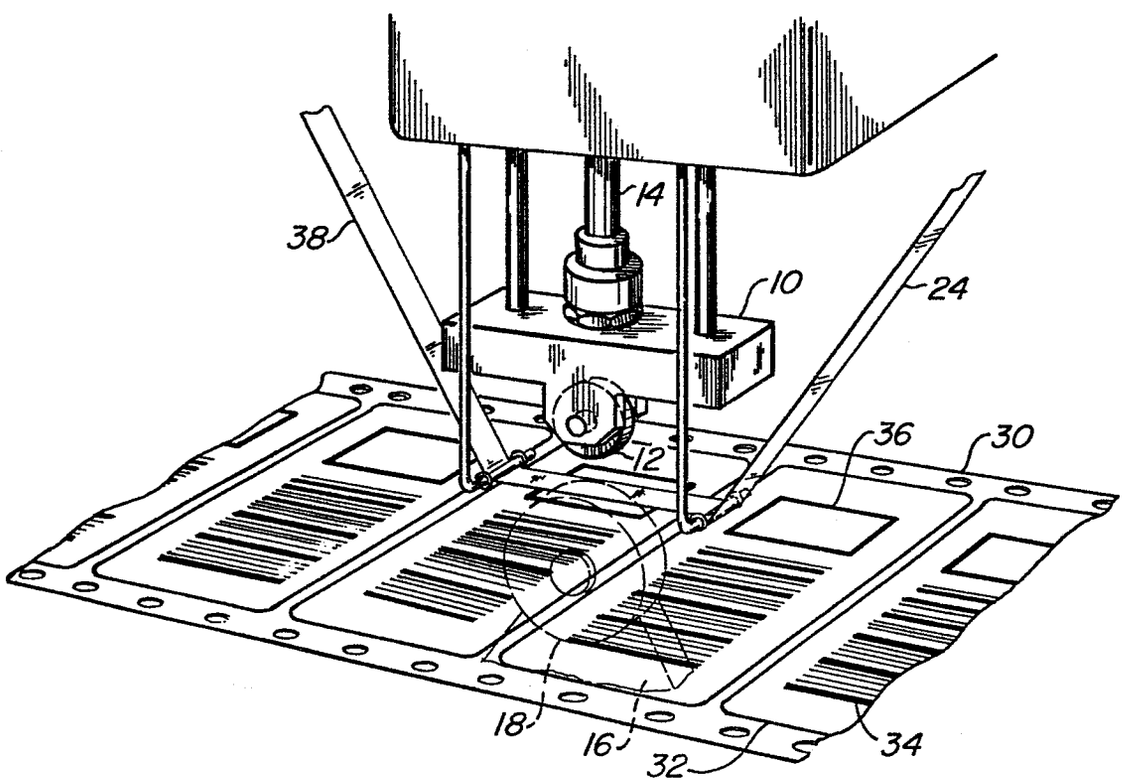


FIG-3

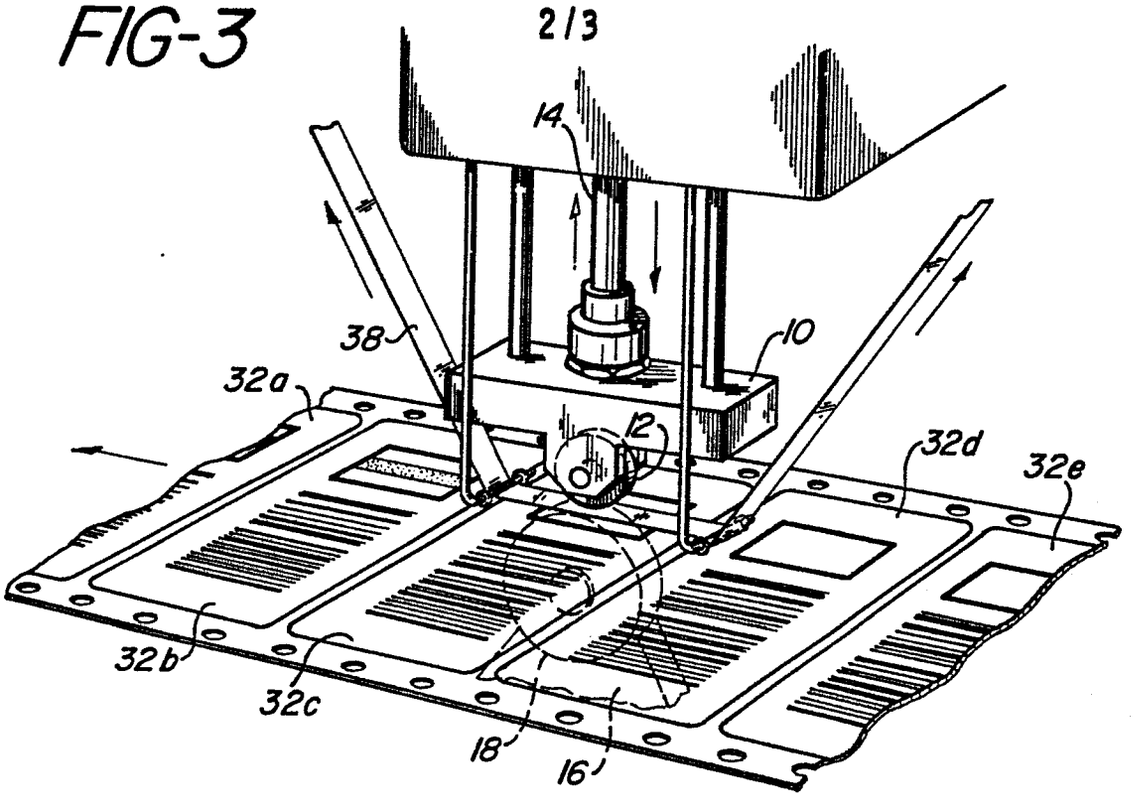


FIG-4

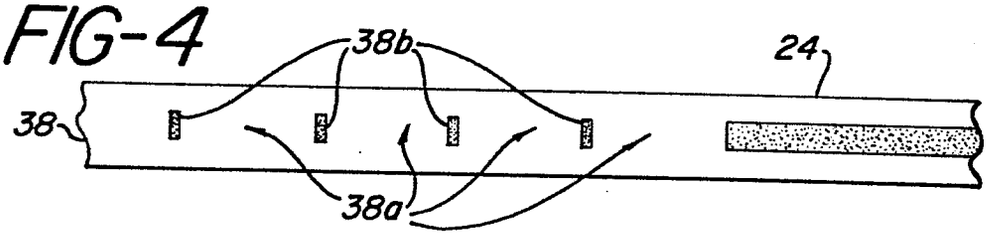


FIG-5

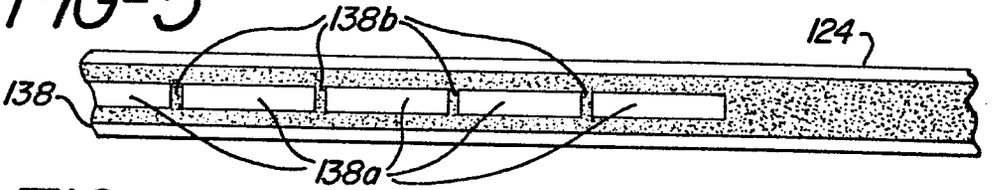


FIG-6

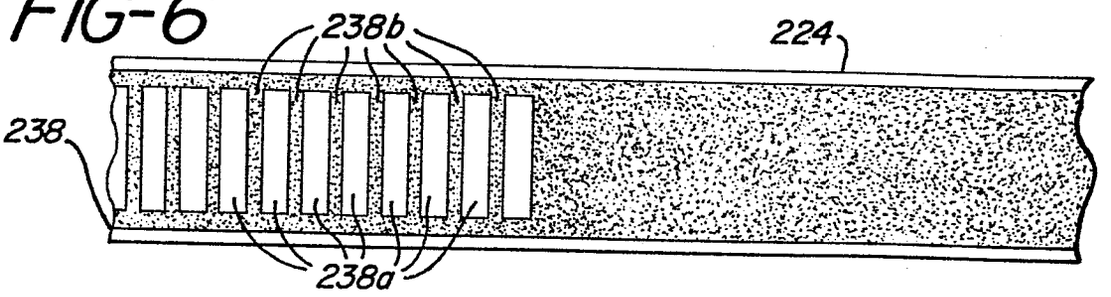


FIG-7

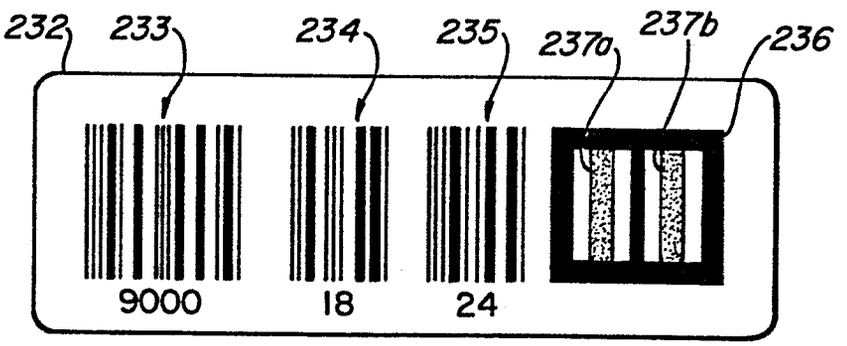


FIG-8