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FLAW DETECTION METHOD USING FLUORESCENT PENETRANT AND A FLUORESCENT DEVELOPER

Sydney G. Thornbury, San Pedro, Calif., assignor, by mesne assignments, to Purex Corporation, Ltd., a corporation of California

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This invention relates to procedure and compositions for non-destructive testing of bodies which may be composed of metal, ceramic or plastic, to detect flaws and cracks in the surface of such bodies, and is particularly concerned with a novel method for application of fluorescent dyes to such bodies in order to facilitate inspection thereof for cracks or defects extending into the body from the surface thereof, and to novel developing compositions for developing maximum contrast between the fluorescent dye retained in and seeping from the surface outlets of the cracks or defects, and the surrounding portions of the test body.

In known penetrant inspection methods for rapid location and evaluation of surface flaws or cracks in test bodies or parts, a penetrant composition containing a fluorescent dye and which will penetrate the openings of the surface cracks or flaws in the part, is applied to the surface of the test body, and the excess penetrant composition is removed from the surface of the body. A developer composition is then applied to this part surface. Such developer can be in the form of a light colored powder, which acts as a wick and causes the liquid penetrant containing the fluorescent dye which was retained in the cracks or surface flaws, to be drawn up out of the surface defects by capillary action. The part is then exposed to invisible fluorescigenous light, and the location of the surface flaws is revealed by the emission of visible fluorescent light by the penetrant dye which was retained in the cracks or flaws after the penetrant composition was removed from the surface of the part.

In order to increase the sensitivity of fluorescent penetrant inspection methods, it has been sought to increase the brightness of fluorescence of the fluorescent penetrant dye and to increase the contrast between the light received from the fluorescent penetrant indicator and from adjacent areas of the test part.

It is an object of the instant invention to provide a novel procedure for controlling the contrast produced between a fluorescent penetrant in the testing for flaws and cracks in test bodies, and the surrounding area of the test body.

Another object is to provide a dye penetrant inspection process to test for cracks and imperfections in parts, employing a penetrant containing a fluorescent dye, which permits obtaining a sharp contrast between the light emitted from the fluorescent penetrant, indicating the location and nature of such cracks and imperfections, and the adjacent areas of the part.

Still another object is the provision of a dye penetrant inspection process employing a penetrant containing a fluorescent dye, wherein the surrounding surface area or background of the part is colored by a second dye, the light emitted from the fluorescent penetrant at the location of the cracks and flaws in the surface of the part being of a color contrasting with the color of the surrounding surface of the part imparted by said second dye.

A still further object is to afford a dye penetrant inspection process employing a penetrant composition containing a first fluorescent dye and a developer composition containing a second fluorescent dye having a wave length emission band different from, and bearing a certain relation with respect to, the wave length emission band of the

first fluorescent dye in the penetrant, whereby the light emitted from the fluorescent penetrant at the location of the cracks and flaws in the surface of the part is of a color which contrast with the color of the surrounding surface of the part imparted thereto by the second fluorescent dye in the developer composition.

A still further object is to provide novel developer compositions particularly adapted for use in the afore-mentioned processes.

Other objects and advantages of the invention will appear hereinafter.

The invention is based on the discovery that if two fluorescent dyes, having different wave length emission spectra wherein at least a portion of the dominent emission wave band of one of said dyes is within or overlaps the dominant absorption wave band of the other of said dyes, are incorporated, one in the penetrant composition and the other in the developer composition, and are used in a dye penetrant inspection process of the nature described above, the fluorescent penetrant dye in the surface cracks and flaws of the part when irradiated with fluorescigenous light, produces a fluorescent color of marked contrast and brightness with respect to the surrounding background or surface areas of the part which are colored by the fluorescent developer dye. By the term "dominant emission wave band" I mean the wave band which characterizes the visible color of the fluorescent dye.

Of the two above noted dyes, the fluorescent dye having the dominant emission band of shorter wave length can be incorporated either in the developer or in the penetrant composition. My process facilitates obtaining information concerning the location and nature, e.g. the width and depth, of cracks and imperfections in the surface of a test body, and also eases the strain on the eyes of the inspector during irradiation of such bodies.

In preferred practice, I employ in a dye penetrant inspection process, a penetrant composition containing a first fluorescent dye, and a developer composition containing a second fluorescent dye having a dominant emission spectrum of shorter wave length than the dominant emission spectrum of said first fluorescent dye, and preferably having an emission peak or maximum within its dominant emission band of a wave length substantially coincident with that of the absorption peak or maximum of said first fluorescent dye, the second fluorescent dye being substantially non-absorbing with respect to light of a wave length within the dominant emission band of said first fluorescent dye.

Furthermore, I have found as an additional feature of the invention, that by varying the amount of developer composition containing fluorescent dye applied to the part surface, the intensity of fluorescence from the fluorescent penetrant dye in the location of the cracks and flaws of the part surface can be made to vary as desired. Thus, for example, by increasing the amount of developer containing fluorescent dye or the concentration thereof which is utilized, the intensity of fluorescence from the fluorescent penetrant in the cracks and flaws can be diminished and also the contrast between the fluorescent penetrant dye and the dye in the developer.

As an illustration of the process, but not in limitation thereof, the penetrant composition can contain a first organic dye which fluoresces yellow under a source of fluorescigenous light, such as ultra-violet or "black light." The penetrant composition is applied to the part surface and allowed to remain for a period of time, then the excess is removed by wiping with a rag, which may be solvent impregnated, or by application of an emulsifier, leaving the dye penetrant in the cracks or imperfections in the part surface. A developer composition is then applied, as by spraying, on the part surfaces, such com-

position being, for example, an alcoholic suspension of chalk or talc, containing in addition, a second organic dye which is blue fluorescent when exposed to ultra-violet light. The developer is then dried, leaving a powdery coating over the surface of the part, with the blue fluorescent dye distributed therein. When the part is exposed to fluorescigenous light, the yellow fluorescent penetrant dye in the cracks and flaws fluoreces a bright yellow against a blue surrounding background, produced by the fluorescent dye in the developer coating retained on the part. It was also observed that the brightness of yellow fluorescence from the penetrant dye, due to coaction of the blue fluorescent developer dye therewith in the location of the cracks and flaws, is enhanced as compared to the brightness of the same yellow fluorescent dye, when the same process is employed except omitting the second blue fluorescent dye from the developer composition. I have observed that the fluorescent dye in the cracks will appear yellow until a large amount of blue dye has been sprayed on the part. It was observed that the use of excessive amounts of developer composition results in a gradual transformation of the glow from the yellow fluorescent dye in the surface cracks and flaws of the part, through varying intensities from extremely strong to very weak, depending on the amount of excess developer employed. Thus, the sensitivity of my process may be controlled in such a manner as to enable viewing of as many of the defects as may be desired. For example, this feature permits location only of cracks or imperfections of a relatively large size, where cracks of relatively small size are not detrimental and may be ignored for practical purposes.

While in the above process the fluorescent yellow dye can be incorporated in the developer and the fluorescent blue dye in the penetrant composition, the blue smears and streaks thus emitted from the penetrant composition in the location of the cracks and flaws, against the yellow background produced by the developer dye, do not have the contrast and brightness of the yellow penetrant against the blue background of the above described process.

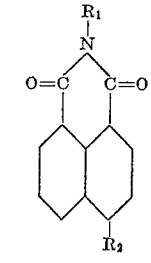
The specific fluorescent dyes which may be employed in the penetrant and in the developer are not critical, but preferably they are chosen to conform to the above described relation particularly as regards difference in wave length of their respective emission spectra. Thus, preferably any fluorescent dye may be employed in the developer having a peak emission wave length shorter than the peak emission wave length of the fluorescent dye incorporated in the penetrant. Any two dyes may be employed in the penetrant and the developer, which exhibit fluorescent properties and which comply with the requirement of Stoke's emission law, the dye of shorter dominant wave length emission spectrum being incorporated preferably in the developer, although if desired the latter type dye can be incorporated in the penetrant. It has been found that brightest fluorescence and greatest contrast as between the color of fluorescence of the penetrant dye and that of the surrounding fluorescent dye in the developer occurs where one of the fluorescent dyes, preferably that in the developer, has an emission peak of wave length substantially coincident with that of the absorption peak of the other fluorescent dye, preferably that in the penetrant. It is preferred to employ fluorescent dyes in the penetrant which have their dominant emission wave band in the green to red portion of the spectrum, and to employ fluorescent dyes in the developer which have their dominant emission wave band in the blue to violet portion of the spectrum.

For example, in place of a yellow fluorescent dye in the penetrant, I can employ a red fluorescent dye in the penetrant and a blue or violet fluorescent dye in the developer. Alternatively, I can employ a red fluorescent dye in the penetrant and a yellow or green fluorescent dye in the developer. The preferred relation for obtaining best contrast, however, is the use of a yellow fluorescent dye in the penetrant and a blue fluorescent dye in the developer.

However, while not preferred in usual practice, I can reverse the fluorescent dyes employed in the penetrant and developer compositions, and incorporate a fluorescent dye in the penetrant having an emission peak of wave length substantially coincident with the wave length of the absorption peak of the fluorescent dye in the developer, said last mentioned dye having an emission peak at a longer wave length than the peak emission of the penetrant dye.

Further, if desired, I can employ one or more fluorescent dyes in the penetrant composition, and one or more fluorescent dyes in the developer. However, where say two fluorescent dyes are used in either or both the penetrant and developer, it is necessary that the basic relation noted above exist, namely that the dominant emission wave band of one of the dyes in the penetrant composition be different from the dominant emission wave band of one of the dyes of the developer composition, and that the dominant emission band of one of such dyes overlap at least a portion of the dominant absorption band of the other of such dyes. The use of a plurality of fluorescent dyes either in the penetrant composition, the developer composition, or both, may be advantageous where intermediate contrasting shades of color as between the penetrant dye showing the location of the surface defects, and the surrounding background developer dye, are desired. However, for simplicity, economy and best results, it is preferred to employ a single fluorescent dye in each of the developer and the penetrant.

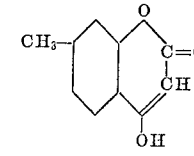
Exemplary of fluorescent dyes which can be employed, for example, in the penetrant are the substituted naphthalimide dyes having the formula:



where R_1 is an alkyl chain such as methyl, ethyl, propyl, butyl, and the like, and R_2 is an amino group, which may be unsubstituted or substituted, e.g. by an alkyl chain such as methyl, ethyl, propyl, butyl, and the like. Specific dyes of this type are Calcofluor Yellow, Color Index—Fluorescent brightening agent No. 4: Flurol 7 GA, Color Index—Fluorescent brightening agent 75; and Azosol Brilliant Yellow 6 GF Color Index—Solvent yellow 44. These dyes are similar in structure except for the R_1 and R_2 substituents in the structural formula above.

Other dyes which may be employed in the penetrant composition include, for example, the rhodamines such as Rhodamine B, Color Index 45170, and Rhodamine 6 GDN, Color Index 45160, Auramine, Color Index 41000, and Eosine G, Color Index 45380. These dyes fluoresce in a color range from greenish yellow to red.

As fluorescent dyes which I have found most suitable for incorporation in the developer are the coumarin derivatives, as exemplified by the dye having the following formula:



Other substituted coumarin derivatives which can be em-

ployed are Calcofluor White RW, Color Index—Fluorescent brightening agent 68, and Blancophor White AW, Color Index—Fluorescent brightening agent 68.

As previously pointed out, if desired, the naphthalimide, Rhodamine, Auramine or Eosine dyes can be incorporated in the developer, and the coumarin dyes employed in the penetrant composition.

The penetrant composition employed in my invention may comprise a conventional solvent vehicle within which the fluorescent dye is soluble. The penetrant vehicle should be a liquid which is itself substantially non-fluorescent and having good wetting properties and the ability to penetrate fine surface cracks and imperfections readily. Satisfactory penetrant vehicles include, for example, petroleum solvents, kerosene, a mineral oil or spirit, or mixtures thereof, light fuel oils, and the like. A specific solvent vehicle found suitable is a mixture of about 70% tributyl phosphate and 30% Polyglycol P1200, believed to be polypropylene glycol having a molecular weight of approximately 1200. Other solvents include, for example, ketones, esters and organic acids. The penetrant may also contain an emulsifying agent which renders the penetrant composition water-emulsifiable. Such emulsifying agents may be, for example, oil-soluble soaps, detergents, and the like. The amount of fluorescent dye incorporated in the penetrant composition may range from about 0.05 to about 2.5%, preferably from about 0.1 to about 1.5%, by weight of such composition.

The dye penetrant composition is maintained on the surface of the test body or part for a period sufficient to permit the composition to penetrate the cracks and imperfections in the part surface, e.g. for about 5 to 30 minutes.

The penetrant composition is then removed or washed off the surface of the part being tested, without being removed from the openings of the surface cracks or flaws. This is accomplished by wiping with a cloth, or a solvent impregnated cloth, or with water where the penetrant composition has been rendered water-emulsifiable by addition thereto of an emulsifying agent, or by a post emulsifying agent where no emulsifying agent has been added to the penetrant composition itself. Such emulsifying agents may be, for example, oil soluble soaps, detergents, wetting agents, or the like, e.g. an alkyl aryl sulfonate or an alkyl aryl polyether alcohol.

The part is then sprayed with a developer composition. Such developer may be a dry developer which contain chalk, talc, silica, silica aerogel, diatomaceous earth, a mixture of silica and talc, or other fine absorbent powdery material such as calcium or magnesium carbonate. Wet developers can also be used, in which a powder such as talc or calcium carbonate in an amount ranging from about 2 to 30% e.g. about 12%, by weight, is suspended in a vehicle such as an organic liquid consisting, for example, of ethanol, isopropanol, or other aliphatic alcohol, a chlorinated hydrocarbon, or other sufficiently volatile hydrocarbon. The amount of fluorescent dye incorporated in the developer composition is small, according to the invention, and generally may range from about 0.2% to about 15%, preferably from about 1 to about 10%, by weight of the absorbent powder. When using a wet developer, the amount of fluorescent dye present can range from about 0.05% to about 2.5%, preferably from about 0.1% to about 1.5%, by weight of such composition. Such developer is allowed to dry by evaporation of the vehicle, e.g. ethyl alcohol, after application to the part surface, to form a continuous powdery coating thereon. The coating on the part has uniformly distributed therein the fluorescent dye incorporated in the developer composition.

The powdery material of the developing agent absorbs the penetrant and fluorescent dye therein, contained in the cracks and flaws of the part surface, by capillary action and forms a fluorescent smear adjacent the crack openings. As an important feature of the invention, when the test body is exposed to fluorescigenous light, the contrast between the fluorescent streaks or smears produced by the fluorescent penetrant in the mouth of the cracks and flaws in the test body, and the surrounding background of the body is substantially enhanced by the presence of a differently colored fluorescent dye distributed throughout the developer coating retained on the test body and forming a contrasting fluorescent colored background for the fluorescent penetrant indicator.

The following examples illustrate practice of my invention:

Example 1

A dye penetrant having the following composition is prepared:

	Percent by weight
(1) Calco Fluor Yellow HEB	0.6
Polyglycol P1200	30.0
Tributyl phosphate	69.4

The penetrant is applied to the surface of a metal test body and maintained thereon for 5 to 10 minutes, and then the surface is wiped clean of excess penetrant composition by means of a cloth or by cleaning with Stoddard solvent or an emulsifier as follows:

	Percent by weight
Mineral oil	20.0
Stoddard solvent	20.0
Hexylene glycol	10.0
Sodium petroleum sulfonate	35.0
Sodium dodecylbenzene sulfonate	15.0

The emulsifier is allowed to remain in the surface from 1 to 10 minutes, is then rinsed away with water, and the test body or part is dried. A developer having the following composition is then sprayed on the part surface.

	Percent by weight
(2) Calcofluor White RW	1.0
Chalk	15.0
Ethyl alcohol	84.0

The developer is then allowed to dry at room or ambient temperature, evaporating off the ethyl alcohol and leaving a coating of powdery developer distributed over the part surface.

The test body is then exposed to fluorescigenous ultraviolet light. Cracks and flaws in the surface of the test body are clearly indicated by bright fluorescent yellow streaks or smears on a blue background covering the surrounding area of the test body.

The emission and absorption characteristics of dyes (1) and (2) above are as follows:

	Dominant Emission Range, A.	Emission, Max., A.	Dominant Absorption Range, A.	Absorption, Maximum, A.
Calcoflour Yellow HEB (1)	4,700–6,000	5,200	4,000–4,700	4,400
Calcofluor White RW (2)	3,900–4,800	4,400	3,500–3,900	3,700

(NOTE.—The visible range is from about 4000 A. to about 7500 A.).

It is seen from the values immediately above, that the dominant emission range of the fluorescent dye (2) in the developer (3900 A.–4800 A.) substantially coincides with the dominant absorption range of the fluorescent dye (1) in the penetrant composition; that the emission peak or maximum of dye (2) (4400 A.) coincides with the absorption peak or maximum of dye (1) (4400 A.); and that the dominant absorption range of dye (2) (3500 A.–3900 A.) is completely outside the dominant emission range of dye (1) (4700 A.–6000 A.).

Example 2

A penetrant inspection procedure similar to that of Example 1 is carried out employing the following penetrant, emulsifier and developer compositions.

Penetrant:

	Percent by weight
(1) Rhodamine B	1.0
(2) Rhodamine 6GDN	0.5
Polyglycol P1200	30.0
Tributyl phosphate	68.5

Emulsifier:

Mineral oil	20.0
Stoddard solvent	40.5
Ethyl cellulose	5.0
Potassium tallate	14.0
Sodium petroleum sulfonate	20.5

Developer:

(3) Calcofluor Yellow HEB	2.0
Ethyl alcohol	80.0
Chalk	18.0

When the processed test body is exposed to ultra-violet light the dye at the location of the cracks and flaws in the surface of the test body fluoresces bright red against a yellow background covering the surrounding area of the test body.

The emission and absorption characteristics of dyes (1), (2) and (3) above are as follows:

	Dominant Emission Range, A.	Emission, Max., A.	Dominant Absorption Range, A.	Absorption, Max., A.
(1) Rhodamine B	5,500–7,000	6,000	4,800–6,000	5,500
(2) Rhodamine 6GDN	5,300–6,000	5,000	4,800–6,000	5,200
(3) Calcofluor Yellow HEB	4,700–6,000	5,200	4,000–4,700	4,400

It is noted in this example that two Rhodamine dyes are employed in the penetrant and that Calcofluor yellow HEB is employed in the developer, whereas in Example 1 above, the latter dye was employed in the penetrant.

Further, from the emission and absorption data above, it is seen that the dominant emission spectrum of dye (3) in the developer (4700 A.–6000 A.) is substantially within the dominant absorption range of dyes (1) and (2) in the penetrant (4800 A.–6000 A.); the emission peak of dye (3) (5200 A.) coincides with the absorption peak of dye (2); and the dominant absorption range of dye (3) is entirely outside the dominant emission ranges of dyes (1) and (2).

Example 3

The procedure of Example 1 is repeated employing the same emulsifier as in Example 1 and the same developer composition as in Example 2, but employing as penetrant the following composition:

	Percent by weight
Rhodamine 6GDN	0.6
Tributyl phosphate	69.4
Polyglycol P–1200	30.0

When the processed test body is exposed to fluorescigenous light, the penetrant dye at the mouth of the cracks and imperfections in the test body surface forms fluorescent red streaks or smears against a yellow background provided by the dye distributed throughout the coating of the developer retained over the surface of the test body.

The emission and absorption relationships between Calcofluor Yellow HEB in the developer and Rhodamine 6GDN employed in the penetrant are pointed out above in Example 2.

Example 4

The procedure of Example 1 is carried out on a test body, except reversing the dyes in the penetrant and developer compositions of Example 1, that is, employing Calcofluor White RW in the penetrant and Calcofluor Yellow HEB in the developer.

When the test body is exposed to fluorescigenous or black light, blue smears are observed at the location of the cracks or flaws, against a yellow background provided by the yellow fluorescent dye distributed throughout the developer coating covering the surface of the test body.

From the foregoing, it is seen that the invention provides an improved procedure for penetrant dye inspection purposes, resulting in a combination of distinct advantages over heretofore practiced processes, namely, enhanced contrast provided between the fluorescent dye penetrant and the surrounding background of the test body, which emits a fluorescent color contrasting with that of the penetrant dye, (2) the brightness of one of the fluorescent dyes, e.g. the penetrant dye, is increased by the presence of the other fluorescent dye, e.g. the dye in the developer, and (3) the degree of contrast between the fluorescent penetrant dye at the location of the cracks and flaws in the part surface, and the background of the part due to light emission by the fluorescent dye distributed in the developer coating, can be controlled as desired to vary said contrast.

While I have described particular embodiments of my invention for the purpose of illustration, it should be understood that various modifications and adaptations thereof may be made within the spirit of the invention as set forth in the appended claims.

I claim:

1. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing a second fluorescent dye to said test body, said fluorescent dyes having different wave length emission spectra, at least a portion of the dominant emission band of one of said dyes being within the dominant absorption band of the other of said dyes, and said one of said dyes being substantially non-absorptive within the dominant emission band of said other of said dyes, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

2. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing an absorbent powder and a second fluorescent dye to said test body, said second fluorescent dye having a wave length emission spectrum shorter than the wave length emission spectrum of said first fluorescent dye, at least a portion of the dominant emission band of said second fluorescent dye being within the dominant absorption band of said first fluorescent dye, said second fluorescent dye being substantially non-absorptive within the dominant emission band of said first fluorescent dye, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and

flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

3. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing an absorbent powder and a second fluorescent dye to said test body, said fluorescent dyes having different wave length emission spectra, one of said dyes having an emission peak within its dominant emission band, of wave length substantially coincident with that of the absorption peak of the other of said dyes, and said one of said dyes being non-absorptive within the dominant emission band of said other of said dyes, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

4. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing an absorbent powder and a second fluorescent dye to said test body, said second fluorescent dye having a dominant emission spectrum of shorter wave length than the dominant emission spectrum of said first fluorescent dye, said second fluorescent dye having an emission peak within its dominant emission band, of wave length substantially coincident with that of the absorption peak of said first fluorescent dye, said second fluorescent dye being non-absorptive within the dominant emission band of said first fluorescent dye, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

5. The method of inspecting bodies for cracks and flaws comprising applying a fluorescent penetrant composition containing a yellow fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing an absorbent powder and a blue fluorescent dye to said test body, at least a portion of the dominant emission band of said blue fluorescent dye being within the dominant absorption band of said yellow fluorescent dye, said blue fluorescent dye being non-absorptive within the dominant emission band of said yellow fluorescent dye, retaining the resulting developer coating having said blue fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said yellow dye, against the colored background produced by said blue fluorescent dye.

6. The method of inspecting bodies for cracks and flaws comprising applying a fluorescent penetrant composition containing a naphthalimide fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing an absorbent powder and a coumarin fluorescent dye to said test body, the emission peak within the dominant emission band of said courmarin dye having a wave length substantially coincident with that of the absorption peak of said naphthalimide fluorescent dye, said coumarin dye being non-absorptive within the dominant emission band of said naphthalimide fluorescent dye, retaining the resulting developer coating having said coumarin fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said naphthalimide dye, against the colored background produced by said coumarin fluorescent dye.

7. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye in an organic solvent vehicle to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, applying an emulsifier for said penetrant composition to said surface to remove excess penetrant composition from said surface, applying a developing composition containing an absorbent powder and a second fluorescent dye to said test body, said fluorescent dyes having different wave length emission spectra, at least a portion of the dominant emission band of one of said dyes being within the dominant absorption band of the other of said dyes, and said one of said dyes being non-absorptive within the dominant emission band of said other of said dyes, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

8. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye in an organic solvent vehicle to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, applying an emulsifier for said penetrant composition to said surface to remove excess penetrant composition from said surface, applying a developing composition containing an absorbent powder and a second fluorescent dye, suspended in a liquid vehicle to said test body, said second fluorescent dye having a dominant emission spectrum of shorter wave length than the dominant emission spectrum of said first fluorescent dye, said second fluorescent dye having an emission peak within its dominant emission band, of wave length substantially coincident with that of the absorption peak of said first fluorescent dye, said second fluorescent dye being non-absorptive within the dominant emission band of said first fluorescent dye, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

9. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a yellow naphthalimide fluorescent dye in an organic solvent vehicle to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, applying an emulsifier for said penetrant composition to said surface to remove excess penetrant composition from said surface, applying a developing composition containing an absorbent powder and a blue coumarin fluorescent dye, suspended in a liquid vehicle, to said test body, said blue

fluorescent dye having an emission peak within its dominant emission band substantially coincident with the absorption peak of said yellow fluorescent dye, said blue fluorescent dye being non-absorptive within the dominant emission band of said yellow fluorescent dye, retaining the resulting developer coating having said coumarin fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said yellow naphthalimide dye, against the colored background produced by said blue coumarin fluorescent dye.

10. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent material to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing a second fluorescent material to said test body, said fluorescent materials having different wave length emission spectra, at least a portion of the dominant emission band of one of said materials being within the dominant absorption band of the other of said materials, and said one of said materials being substantially non-absorptive within the dominant emission band of said other of said materials, retaining the resulting developer coating having said second fluorescent material distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first material, against the colored background produced by said second fluorescent material.

11. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent material to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing a second fluorescent material and an absorbent powder to said test body, said fluorescent materials having different wave length emission spectra, at least a portion of the dominant emission band of one of said materials being within the dominant absorption band of the other of said materials, and said one of said materials being substantially non-absorptive within the dominant emission band of said other of said materials, retaining the resulting developer coating having said second fluorescent material distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first material, against the colored background produced by said second fluorescent material.

12. The method of inspecting bodies for cracks and flaws comprising applying a fluorescent penetrant composition containing a yellow fluorescent material to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition containing a blue fluorescent material to said test body, at least a portion of the dominant emission band of said blue fluorescent material being within the dominant absorption band of said yellow fluorescent material, said blue fluorescent material being non-absorptive within the dominant emission band of said yellow fluorescent material, retaining the resulting developer coating having said blue fluorescent material distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said yellow material, against the colored background produced by said blue fluorescent material.

13. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition to said test body, said developing composition containing an absorbent powder and from about 0.2% to about 15% of a second fluorescent dye by weight of said powder, said fluorescent dyes having different wave length emission spectra, at least a portion of the dominant emission band of one of said dyes being within the dominant absorption band of the other of said dyes, and said one of said dyes being substantially non-absorptive within the dominant emission band of said other of said dyes, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

14. The method of inspecting bodies for cracks and flaws, comprising applying a fluorescent penetrant composition containing a first fluorescent dye to a test body, permitting said penetrant to remain on the test body for a period sufficient to cause said penetrant to enter cracks and flaws on the surface of said body, removing penetrant composition from the surface of said test body, applying a developing composition to said test body, said developing composition containing an organic liquid vehicle, about 2 to about 30% by weight of an absorbent powder, and from 0.05 to about 2.5% by weight of a second fluorescent dye, said fluorescent dyes having different wave length emission spectra, at least a portion of the dominant emission band of one of said dyes being within the dominant absorption band of the other of said dyes, and said one of said dyes being substantially non-absorptive within the dominant emission band of said other of said dyes, retaining the resulting developer coating having said second fluorescent dye distributed therein on said body, and inspecting said test body under fluorescigenous light to locate cracks and flaws in said surface as indicated by fluorescent emission from said first dye, against the colored background produced by said second fluorescent dye.

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