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[54] **METHOD OF DEVELOPING VESICULAR PHOTOGRAPHIC MATERIALS**


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**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 866,770, Oct. 15, 1969, abandoned, which is a continuation of Ser. No. 569,015, Aug. 1, 1966, abandoned.

[52] **U.S. Cl.** ..... **96/49,** 96/27 R, 96/48 HD, 96/67, 96/75, 96/88, 96/91 R, 96/91 N, 96/115 R, 96/35.1, 250/65 T

[51] **Int. Cl.** ..... **G03c 5/18,** G03c 5/34

[58] **Field of Search** ..... 95/91, 75, 49, 48, 95/115 R, 67, 27, 92, 47, 88; 250/65 T, 65 X; 117/36.7, 36.8, 36.9



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| 2,911,299 | 11/1959 | Baril et al. | 96/49 |
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[57] **ABSTRACT**

A process for producing a vesicular photographic image while minimizing shrinkage of the backing layer upon which the vesicular photographic material is coated. The coating contains, in addition to sensitizer, a dye or pigment which can produce heat on exposure to non-actinic light. The material is exposed, image wise, to actinic light and then exposed uniformly to non-actinic light which is absorbed by the dye or pigment to heat the material and produce an image. Since the dye or pigment is not in the backing, only the vesicular coating is heated. The non-actinic light is of sufficient intensity to develop an image in less than about 0.2 second.


**6 Claims, No Drawings**

# METHOD OF DEVELOPING VESICULAR PHOTOGRAPHIC MATERIALS

This is a continuation-in-part of U.S. application of Norman T. Notley, Ser. No. 866,770 filed Oct. 15, 1969 which in turn is a continuation of U.S. application of Norman T. Notley, Ser. No. 569,051 filed Aug. 1, 1966, both now abandoned.

The present invention relates to photography and, more particularly, to an improved method for making photographs using vesicular photographic materials, and more specifically a negative working system.

A vesicular photographic material is a photographic film capable of forming an image with small bubbles or vesicles of gas which are generated and trapped in the areas of the film exposed to light. Generally speaking, the film comprises a colloid or resin coating, referred to as a vehicle, on a backing material and a light sensitive agent or sensitizer, most commonly a diazo compound dispersed throughout the coating. When the film is selectively exposed to image-defining light, the sensitizer is decomposed and releases molecules of gas (nitrogen in the case of diazo compounds). These ordinarily do not form vesicles immediately, but they do so when the film is developed by heating, presumably because the vehicle is relaxed sufficiently on heating for the gas molecules to form bubbles and for the bubbles to expand. The bubbles reflect and scatter light and render the vehicle opaque to transmission of light in the exposed areas and they also appear white when viewed by reflected light.

The present invention is concerned with "negative-working" development of such films. The term negative working is used to indicate a process in which vesicles appear in areas where the material is struck by image-defining light. In viewing the vesicular photograph produced by light transmitted through it, the photograph willl appear to be a negative of the subject photographed. That is, it will appear dark where the vesicular material was originally struck by light. This is distinguished from positive working or direct image process as described in U.S. Pat. No. 2,911,299, and U.S. Pat. No. 3,457,071. In the latter, bubbles are formed in areas not struck by the image forming light.

In the prior art, negative working vesicular images have been produced by selectively exposing the vesicular material to image defining actinic radiation to form a pattern of exposed areas in the vesicular material, referred to herein as a latent image by analogy to the latent image of silver halide photography, and then by developing said material by relaxing the vehicle, normally with heat.

Ordinarily, heating has been effected by contacting the exposed vesicular material with a material which is maintained at the desired elevated temperature. In the history of vesicular photography, this hot material was at first a hot liquid such as glycerine. Later there were used hot ovens and hot plates. It even has been found possible to use the infra-red energy developed. by passing electric current through a fine grid of nicrome type high resistive wire. At present the most common procedure is to pass the film in contact with a heated rotatable roll.

The hot liquid method was obviously disadvantageous in that the film had to be immersed in the liquid and it was inconvenient to have a pot of hot liquid present for development. The hot plate suffered from lack of uniform heating, especially for larger areas; the wire grid infra-red method suffered from the fact that the amount of infra-red energy was critically subject to voltage fluctuations and thus the development time was hard to control. The hot roll has generally been considered to be the most satisfactory apparatus. However, it too is not entirely satisfactory in terms of overall temperature uniformity and control.



Another difficulty, common to all of these development systems, results from the fact that the temperatures required to effect proper development of vesicular films produce some shrinkage in most all of the practical backing materials or in the emulsion itself, if it is self supporting. For example, Mylar, an oriented polyethylene terephthalate film, has been a preferred backing but it tends to shrink at 250° F which is a preferred development temperature.

Another negative working development method which is known involves instantaneous image formation during exposure. The vesicular material is exposed to a flash of image defining of high intensity. This is analogous to the "second" exposure described in U.S. Pat. application of Notley et al, Ser. No. 533,743 filed Feb. 1, 1966 , now Pat. No. 3,457,071. However there are two practical difficulties limiting the usefulness of this procedure: the image produced is of extremely high contrast and the procedure is not suitable when the vesicular material is used to print from a negative on silver halide film because the silver negative may be damaged by the high intensity light.

In accordance with the present invention, an improved type of vesicular material, after its initial exposure to light, is developed by a second exposure to light. The vesicular material contains uniformly distributed in its vehicle a light absorbing dye or pigment which is heated by exposure to light, e.g., non-actinic infra-red and visible radiation which doesn't decompose it or the sensitizer. The initial or image defining exposure is made in the conventional manner. Development is effected by exposing the film overall to a high intensity light source not including actinic radiation. For example, a high intensity flash lamp may be used if separated from the vesicular material by ultraviolet filter. Since the sensitizers in vesicular films are sensitive to ultraviolet light but not to visible or infra-red light, the filter prevents further decomposition of the sensitizer. The radiation from the light source is absorbed by the dye or pigment in the film and causes local heating in the emulsion which develops the vesicular material. At the same time, if the backing layer does not contain the dye or pigment, it is not heated except much more slowly by heat released by the vehicle.

It will be appreciated that the light source may be either a high intensity flash from a flash tube, a flash of light from a continuous source caused by opening momentarily a shutter positioned between the film and the light source or a continuous source which illuminates a slit past which the film moves at appropriate rate. The light source may in fact be a continuous light source, but if the heating by light is continued it may overheat the backing and cause shrinkage.

The non-actinic light should be of relatively high intensity, so that heat is generated rapidly in the vehicle. This is necessary to compensate for heat losses from the vehicle to the surrounding environment. Correspondingly, once the image is formed, it is not desirable to continue heating; therefore, the exposure to high intensity light exposure should be short. In general, the

light will be of sufficient intensity to cause an image to appear in less than about 0.2 second, preferably less than 0.01 second, and the exposure will not exceed about 0.2 second.

In the vesicular sheet materials used, a wide variety of vehicles may be employed in accordance with the invention. Those preferred are dry, water-resistant, synthetic, water-insoluble, and non-water swelling polymers.

One class comprises esters, ethers and acetal derivatives of polyvinyl alcohol. The ester derivatives are generally obtained by polymerization of esters of vinyl alcohol with aliphatic or aromatic carboxylic acids. The aliphatic acids are preferred, the most suitable being lower fatty and unsaturated acids containing up to about six carbon atoms, such as acetic acid, propionic acid, valeric acid, yinyl acetic acid or crotonic acid. However, higher fatty acids such as octanoic may be used, particularly in combination with lower fatty acids. Suitable aromatic acids include benzoic acid, napthoic acids and pnenyl acetic acid. The ester polymers may be obtained from the monomer by any conventional polymerization method, i.e., bulk, solution or aqueous emulsion or dispersion, in the presence of, e.g., a free radical or ionic catalyst, the details of which form no part of the present invention.

The ether derivatives similarly may be made by polymerization of vinyl ether monomer such as vinyl alkyl ehters. Preferred materials are vinyl lower alkyl ethers containing up to six carbon atoms in the alkyl group, such as vinyl methyl ether, vinyl propyl ether, etc. As in the case of the above-described vinyl esters, any type of addition polymerization may be employed, the details of which form no part of the present invention.

Polyvinyl acetals are generally made by reaction between aldehydes and polyvinyl alcohol or polyvinyl esters such as polyvinyl acetate. It is preferred that saturated lower aliphatic aldehydes be employed containing up to six carbon atoms, particularly butyraldehyde and formaldehyde. However, small amounts of higher aliphatic aldehydes or aromatic aldehydes such as benzaldehyde may be involved.

It will be appreciated that, while the above description of preferred polymers has been directed to homopolymers, copolymers containing more than one acetal, ester or ether group may be used. Thus, polyvinyl acetals may contain two or more types of acetal groups or, e.g., acetate units as well as acetal. In addition, relatively minor amounts of other ethylenically unsaturated monomers containing one or more



groups may be present in this class of preferred polymers, e.g., up to 5%, as long as the characteristics of the polymer are essentially not altered so as to render it unsuitable.

Vehicles of the aforesaid type are more fully described in Notley et al applications Ser. Nos. 403,633 and 405,597 filed Oct. 13, 1964 and Oct. 21, 1964, respectively both now abandoned. However the following U.S. Pats. have issued from continuation applications of the above mentioned Notley et al. applications: 3,498,786; 3,552,961; 3,552,962; 3,552,963; 3,552,964; 3,552,965; and 3,653,902.

Solid, high molecular weight polystyrene also may be used. In its preferred form, the polymer is a homopolymer or may contain minor amounts, e.g., up to 5 percent of other ethylenically unsaturated monomers such as methyl methacrylate. In most cases, larger amounts may be used, as long as the fundamental characteristics of the polymer are not altered so as to render it unsuitable.

An important class of preferred vehicles includes those described in James U.S. Pat. No. 3,032,414, Parker et al U.S. Pats. Nos. 3,161,511 and 3,251,690, Daech Pat. No. 3,189,455 and Notley et al application Ser. No. 463,940 filed June 14, 1965, now Pat. No. 3,383,213, characterized by a permeability constant for nitrogen within the range $8.6 \times 10^{-16}$ and $8 \times 10^{-10}$, said constant being the number of cubic centimeters of nitrogen transmitted at 30° C by an area of 1 square centimeter in one second when the pressure gradient is one centimeter of mercury. Such polymers include polyvinylidene chloride, polyvinyl chloride, copolymers of vinyl chloride and vinylidene chloride, vinyl chloride and acrylonitrile, styrene and acrylonitrile, acrylonitrile and 1,1-difluoroethylene, vinylidene chloride and acrylic acid, vinyl acetate and vinylidene cyanide, vinyl chloride and acrylic acid, vinyl chloride and methyl acrylate, vinylidene chloride and ethyl acrylate, vinylidene chlorofluoride and acrylonitril, vinylidene chloride and methyl methacrylate, vinyl acetate and vinylidene chloride, vinyl alcohol and vinylidene chloride, vinyl chloride and diethyl maleate, and vinyl chloride and vinyl acetate, ethyl cellulose, copolymers of alkyl acrylates and methacrylates with acrylonitrile, polymers of methacrylonitrile and nylons.

Still another useful class of vesicular materials are those containing gelatin or other hydrophilic polymers and a hardening agent, as described in Parker et al, U.S. Pat. No. 3,081,169.

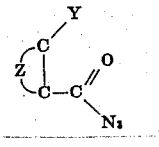
The vehicles may also contain various modifiers of physical properties, as described in the above-listed patents and applications.

It will be appreciated that while numerous examples have been given, virtually any solid relatively rigid and inelastic plastic, and preferably thermoplastic, material is a potentially useful material as long as it is sufficiently inelastic and rigid to retain the microscopic gas bubbles or cavities after they have formed. In some cases, softer polymers may be used if a mechanism is provided for hardening them after the vesicles are formed. However, in view of the large number of polymeric materials which are highly satisfactory, the use of such softer materials is regarded for the most part as unnecessary.

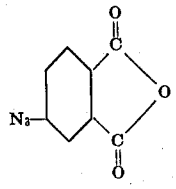
It is a requirement that the image defining exposure produce a latent developable image. That is, when some relatively soft polymers are used as vehicles, gas diffuses from them rapidly after exposure, before the film can be developed. It is disclosed in the aforesaid Notley application Ser. No. 533,743 that an image can be produced in these when the actinic radiation is of high intensity and there is instantaneous image formation. This is possible because bubbles are formed before the gas can escape. However, in the present invention, such materials are not suitable because the image is produced in a separate development step after exposure to actinic radiation. That is the vehicle must be capable of forming latent image which can be developed. For purposes of the present invention, therefore, the vesicular photographic material, after exposure to image defining actinic radiation, should be capable of

forming a visible vesicular image if placed in contact with a heated surface maintained at a temperature above room temperature and up to 300° F.

The above polymers are substantially uniformly blended with a light decomposable agent, or sensitizer, of the types which are known in the art of vesicular photographic materials which, upon exposure to light, decompose into products which are volatile upon warming to form the above-described radiation scattering cavities. The preferred sensitizers are non-reactive to the vehicle and, upon exposure to light, decompose into products which are chemically non-reactive to said vehicle and which are volatile to form radiation scattering discontinuities only in the light struck areas in said vehicle to thereby furnish a record. Of these preferred sensitizers, those which are especially useful are of the type which decompose to release nitrogen on exposure to light, particularly the diazonium salts. Suitable sensitizers include the diazo compounds which release nitrogen on exposure to light, as disclosed in U.S. Pats. Nos. 3,032,414, 2,923,703 and 2,976,145, for example, p-diazo diphenylamine sulfate, p-diazo diethylaniline zinc chloride, p-diazo ethyl hydroxyethylaniline zinc chloride, p-diazo ethyl methyl aniline zinc chloride, p-diazo diethyl methyl aniline zinc chloride, p-diazo ethyl hydroxyethylaniline zinc chloride, 1-diazo-2-oxy naphthaline-4-sulfonate, p-diethyl amino bezene diazonium chloride $ZnCl_2$, 4-benzolamino-2-5-diethoxy benzene diazonium chloride, p-chlorobenzene-sulfonate of 4-diazo-1cyclohexylaniline, p-chlorobenzene-sulfonate of 4-diazo-2-methoxy-1-cyclohexylamino benzene, tin chloride double salt of 4-N-methylcyclohexyl-amino-benzene diazonium chloride, p-acetamino benzene diazonium chloride, 4-dimethylamino benzene diazonium chloride, 3-methyl-4-diethyl amino benzene diazonium chloride, 4-morpholino benzene diazonium chloride, 4-piperidyl-2, 5-diethoxy benzene diazonium chloride, 1-dimethyl amino napthaline- 4-diazonium chloride, 4-phenyl amino diazo benzene diazonium chloride. Other useful sensitizers are those disclosed in British Specification 956, 336 published Apr. 22, 1964 and having the general formula



in which Y represents hydroxyl, amino, alkylamine, arylamine, or merca to and Z represents the atoms necessary to form a cyclic structure, and those disclosed in French Pat. No. 1,281,905 having the general structure.



The amount of sensitizer will be 5.0 to 20.0 percent, based on the weight of the vehicle, preferably 10.0 to 16.0 percent.

Substantially any material may be used as the pigment or dye if it is inert to the vehicle and the sensitizer and if it has suitable spectral properites. It must be capable of absorbing non-actinic radiation, i.e., radiation which does not decompose the sensitizer or the dye or pigment.

When a substance absorbs non-actinic radiation, it is increased in energy. This energy may take the form of translational kinetic energy and rotation of individual molecules and vibrations and electronic excitations within the molecules. In effect, this corresponds to a rise in temperature. As the molecules collide with other molecules which have not absorbed light, part of this energy is transferred, until a state of equilibrium is restored. A very useful discussion of these phenomena will be found in the textbook *Introduction to Chemical Physics*, by J.C. Slater (1939).

In the vesicular materials used in the present invention, the dye or pigment in the vehicle absorbs light and transfers energy to the surrounding polymeric vehicle. This causes rapid heating of the vehicle and a vesicular image is formed. At the same time the backing which does not contain the dye or pigment, is not heated rapidly but only by slow transfer of heat from the vehicle. Since heat is being dissipated to the surrounding environment at the same time, the backing is not overheated.

Numerous materials are useful as dyes and pigments for practicing the invention, but black pigments based on carbon are particularly useful. The amount generally is about 0.5 to 5 percent by weight of the vehicle. The precise amount used will depend on the absorption coefficient of the dye or pigment, the wavelength at which it absorbs and its ability to transfer energy to the vehicle. The dye or pigment also tends to increase the contrast of the photograph produced and this factor also should be considered. However, it is rather easy to make up batches using, say, 1, 2, 3, 4 and 5 percent of a given pigment in a vesicular material, and expose and develop them. Selection of the proper amount of dye or pigment can then be made by visual inspection of the samples.

One embodiment of the invention which may be useful in certain circumstances is based on using, as part or all of the dye or pigment, a substance which may be decomposed by the initial image exposing radiation. For example, the sensitizer may form a decomposition product which is opaque to non-actinic radiation. Thus, diazo sensitizers are believed to produce phenols as photo-decomposition products. If the phenol is opaque, say, to infra-red radiation, it may absorb infra-red during the second exposure. Generally, it is not considered desirable to have colored photo decomposition products in a vesicular photograph, but this embodiment may be useful where this is not objectionable or where the photo decomposition product is an infra-red absorber.

The dye or pigment must be selected with regard to the portion of the electromagnetic spectrum used during development. If the dye or pigment absorbs infra-red but not visible radiation, it will be invisible to the eye but will still function. In principle the invention can be used with very short wavelength radiation such as X-rays, provided the sensitizer is unaffected, and materials which absorb X-rays would be used for the dye or pigment. At the other end of the spectrum, microwaves can be used. In that instance, the dye can be, for example, water which is absorbed into the vehicle. For instance, diazo sensitizers tend to be water soluble and

when films containing them are equilibrated, will retain a small amount of water in the vehicle where it can function as the dye or pigment. Water also absorbs infra-red energy efficiently and can be used as the dye or pigment with that portion of the spectrum.

The vehicle, sensitizer and pigment or dye may be combined by any suitable method. However, it is preferred that the resin and sensitizer, and preferably also the pigment or dye each be dissolved in a solvent and the resultant solutions combined, since this provides a highly uniform distribution of sensitizer in the polymer. If the pigment or dye is not soluble it should be well dispersed. In this embodiment it is only necessary that the respective solvents be mutually miscible. For the most part, polar solvents will be used such as alcohols, ketones, nitriles, esters, ethers and halogenated solvents. Particularly useful are methyl, ethyl and isopropyl alcohols, alkyl acetates, acetone, methyl ethyl ketone, dioxane and acetonitrile. However, any inert solvent which meets the above miscibility requirements may be used.

The solution obtained is coated on any suitable backing layer, either transparent or opaque, such as glass, paper, Mylar (oriented polyethylene terephthalate film), polyethylene film or polypropylene film as disclosed in U.S. Pats. Nos. 2,950,194 and 3,037,862. The solutions are dried by evaporation and the films are ready for use. The dry coating thickness usually is about 0.02 to 2 mils, preferably 0.30 to 0.70 mil.

The light sources used for the respective exposures will be selected in relation to the absorption characteristics of the pigment or dye and the sensitizer. However, ordinarily the sensitizer will be a diazo compound and the actinic radiation will be in the range 3500–4500 Angstrom units. A mercury arc lamp is particularly useful as a source and high intensity incandescent lamps also are quite useful.

For the second exposure, it is necessary to omit actinic radiation. In terms of diazo-sensitized films, this means that wavelengths shorter than about 4500 Angstom units are omitted, although as mentioned above, very short wavelengths may be used, such as X-rays. The most useful way to achieve wavelengths longer than 4500 Angstrom units is to use a high intensity light source and hold back light of wavelength shorter than 4500 Angstrom units with a filter. A very suitable lamp for this purpose is a gas discharge tube of the type used in an ordinary photographic flash gun. A suitable filter would be Wratten filter K2 (No. 8) described in *The Handbook of Chemistry and Physics* 44th Edition, (1961) pages 3123–3126.

The aforesaid flash tubes also produce a fair amount of infra-red radiation and can be used when infra-red is desired. Beyond those wavelengths lies the microwave region which also may be used. However, in this instance the frequencies to be used are limited by law. Various portions of the microwave, UHF, VHF and lower frequency bands are assigned for various purposes, for example television and communications transmissions, etc. In the microwave bands, certain frequency bands are available and are used, e.g., for microwave ovens, which can be used as an energy source.

It will be appreciated that, in principle, other frequencies could be used and they are excluded on legal rather than scientific grounds. Therefore, it will be understood that the term "radiation" as used with respect to the development step, refers to any portion of the electromagnetic spectrum which does not decompose the sensitizer and/or the dye or pigment.

The invention is illustrated by the following examples wherein parts and percentages are by weight unless otherwise indicated.

## Example I

The following were assembled:

| Part A | Parts by weight |
|---|---|
| Vinylidene chloride-acrylonitrile copolymer (Saran F-120) | 100 |
| Polymethylmethacrylate | 16 |
| Methylethylketone (MEK) | 350 |
| Superchrome black (BR)* (extra concentrated 150%) | 1.5 |
| Part B | |
| p-diazo N, N-dimethylaniline 1/1 zinc chloride salt | 15 |
| Methanol | 105 |

*A black dyestuff

The ingredients in Part A were combined and ball-milled until the polymer went into solution. The ingredients in Part B then combined by warming the methanol to 50° C and adding the diazo. The A and B parts were then combined and coated on a 5 mil polyester base at a thickness of 0.5 mils using a Byrd vacuum plate and a Gardner laboratory coating knife. The film was dried for five minutes in a 140° F oven and cured for 5 minutes in a 240° F oven. The sheet was then placed in contact with an original and exposed through it to actinic radiation from a 400 watt mercuy arc lamp resulting in an image defining exposure on the vesicular material. This material was then covered with an ultraviolet filter and flashed with a 200 watt G.E. flash unit. The resulting negative image of the original was sharply defined and had good density.

## EXAMPLE 2

Example I was repeated except that 1.2 parts by weight of FerroColor 302 black pigment was substituted for the Superchrome black. A good sharp negative image was obtained.

## EXAMPLE 3

A sample of film was used of the type described in Example I of James, U.S. Pat. No. 3,032,414. The film was exposed through a transparency to sunlight and was developed by microwave radiation. The source of radiation was a Litton Microwave Heating Tube operating at 2450 megahertz. The film was developed in five seconds to a maximum density of 1.3 *f*/4.5 above a fog density of 0.22. The effect is believed to be caused by the small amount of moisture present in the vesicular film.

A similar experiment was attempted with the film moistened on its surface just prior to development. However, development was spotty indicating that moisture on the surface had absorbed the energy and acted as an external developer.

## EXAMPLE 4

Another sample of the film referred to in Example 3 was exposed to sunlight through a transparency and developed by radiation from a 40 watt carbon dioxide laser tube emitting at a wavelength of 10.6 microns. The film achieved a maximum density of 2.6.

The advantages of the present method over the prior art are several. The time required for development in this manner may be much shorter than previously possible, as short as 1/800 to 1/10,000 of a second for a flash tube. Also since heating takes place locally in the emulsion and not in the base or support, a tendency for the base to shrink when heated is not a problem. A further advantage is the possibility of selective development. In applications such as microfiche, a large sheet of vesicular material may be exposed in various small areas at different times. Previously, selective development of these areas proved difficult for a small heating platen, maintained at the proper temperature, had to be positioned accurately and pressed against the film. In the present invention, this selective development would be done by a burst of light, without necessarily moving the material from the masking for the image defining exposure. This "add-on" microfiche feature permits the updating of a fiche with a frame of later information. Yet another important advantage is that the process may be carried out with the same equipment as used in the positive-working process described in said Notley application, Ser. No. 533,743. The equipment includes two exposure sources, one supplying actinic radiation of relatively low intensity and the second a flash of non-actinic radiaton of very high intensity. Flash light sources useful in the second exposure also generate large amounts of non-actinic radiation. Therefore, it may also be used in the present negative-working process if actinic radiation is held back by a filter.

Various changes may be made in details of the process and materials, described above for purposes of illustration without departing from the principles of the invention. The scope of the invention is not intended to be limited thereby, but is defined in the appended claims.

I claim:

**1.** A process for producing a negative projection vesicular photographic image which comprises the steps of exposing imagewise to actinic radiation

a vesicular photographic material comprising

A. a backing layer and

B. coated on said backing a polymeric vehicle in which are dispersed (1) a member of the group consisting of pigments and dyes which absorb visible light and produce heat upon absorption of visible light and (2) a light decomposable agent which, on exposure to actinic radiation, decomposes to produce products which are volatile on warming said vehicle to form radiation scattering cavities in said vehicles to form a latent developable image,

and thereafter exposing said vesicular photographic material overall for less than about 0.2 second to non-actinic visible radiation which is absorbed by said member of the group consisting of pigments and dyes but not by said light decomposable agent, said non-actinic radiation being thereby absorbed and heating said vehicle to develop said latent developable image to a vesicular photographic image having vesciles in areas of said vesicular photographic material exposed during the imagewise exposure, the intensity of said non-actinic radiation being sufficient for the energy absorbed from it by said vehicle containing said member of the group consisting of pigments and dyes to cause an image to appear in said material in less than about 0.2 second,

said backing layer being transparent to said non-actinic radiation and being heated only by heat transferred from said vehicle, thereby minimizing heat shrinkage of said backing layer.

**2.** A process as set forth in claim **1** in which said light decomposable agent is a diazo compound, said actinic radiation has a wavelength in the range 3500–4500 angstrom units and said non-actinic radiation has a wavelength longer than 4500 angstrom units.

**3.** A process as set forth in claim **1** in which the intensity of said non-actinic radiation is sufficient to develop said vesicular photographic image in less than 0.01 second.

**4.** A process as set forth in claim **1** in which said vehicle comprises a mixture of (1) a copolymer of vinylidine chloride with acrylonitrile and (2) polymethyl methacrylate and said light decomposable agent is p-diazo-N, N-dimethylaniline 1/1 zinc chloride salt.

**5.** A process as set forth in claim **1** in which said member of the group consisting of pigments and dyes is black and comprises carbon.

**6.** A process as set forth in claim **1** in which said non-actinic radiation is supplied by a gas discharge flash lamp, actinic radiation from said flash lamp being kept from said vesicular photographic material by a filter which does not substantially pass light having a wavelength less than 4500 angstrom units.

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