Patented Feb. 18, 1936

2,030,903

UNITED STATES PATENT OFFICE

2,030,903

PHOTOGRAPHIC FILM OF THE MONOPACK TYPE ADAPTED FOR COLOR PHOTOGRAPHY

Hans von Fraunhofer, New York, N. Y., assignor to Omnichrome Corporation, New York, N. Y., a corporation of New York

No Drawing. Application August 3, 1934, Serial No. 738,298

13 Claims. (Cl. 95—2)

This invention relates to improvements in photographic films of the mono-pack type adapted for color photography, being particularly directed to sensitized multi-strata films adapted for exposure through the emulsion as differentiated from exposure through the carrier, and methods for producing such sensitized multi-strata films.

Attempts have been made to provide stratified mono-pack films which may be exposed from the emulsion side by applying separate layers of color sensitized emulsions one on top of another, onto a carrier such as, for example, an emulsion layer sensitized to the warm color, as, for instance, red, has been deposited on a carrier such as celluloid, and dried. Thereafter, there has been deposited on such layer a second layer of emulsion which may have been previously sensitized to a colder color or which is sensitized to a colder color after application. Color filters have in some instances been added in separate steps. In this manner, a two-layer emulsion has been described wherein exposure may take place in front of the emulsion; however, such procedure is tedious, duplicative and uneconomical.

It is an object of this invention to provide for sensitization of a mono-pack film of a single layer emulsion in a manner as to provide for multi-layer stratification, with the stratum adjacent the carrier being sensitized for the warmer colors and the stratum or strata distant from the carrier and from in front of which exposure may take place, sensitized to the colder colors, such sensitizing operation with respect to the single emulsion layer being a single step procedure.

Broadly, it is an object of this invention to provide for the formation of a multi-strata color sensitive formation in a single emulsion layer disposed on a carrier through the medium of disposing the color sensitizing and filter media on a carrier and coating the carrier with a single layer emulsion, whereupon the color sensitive and filter media are caused to diffuse upwardly into the emulsion to provide a multi-strata sensitization thereof, with the stratum adjacent the carrier being sensitized to the warmer colors and the stratum further distant from the carrier being sensitized to the colder colors, thereby providing for an entrant stratum as regards exposure sensitized to the colder colors and an emergent stratum as regards exposure sensitized to the warmer colors.

To carry out the production of one type of film sensitized for color photography of this type, I apply, for example, a water-proof opaque photographic paper. I coat the water-proof paper with a sub-stratum incorporating gelatine of a thickness of .0001 inch; upon the paper as thus coated I apply as by brushing or spraying a coating of a sensitizing solution incorporating color sensitizers for the warm and cold colors plus filter dyes having absorptive qualities as regards certain color components of white light, such as green and blue, the sensitizing and filter dyes being of varying particle size ranging from crystalloidal to colloidal in an aqueous-alcoholic solution. The respective color sensitizing and filter dye particles penetrate into the gelatine binder forming the sub-stratum on the paper, and after drying the aqueous-alcoholic solution is substantially evaporated, leaving respectively color sensitizing and filter dye particles in suspension within the sub-stratum into which they have diffused.

I thereafter apply a coating of warm standard photographic emulsion incorporating silver salts, of a thickness on the order of .0045 inch, whereupon the emulsion layer unites with the sub-stratum and the color sensitizing and filter dye particles carried in the sub-stratum proceed to diffuse upwardly into the emulsion layer, such diffusion being dependent on the particle size of the dyes, with the result that a multi-strata formation is produced in the emulsion, the respective strata of which are color sensitized, the stratum adjacent the sub-stratum being sensitized to the warmer colors and the strata distant from the sub-stratum or the carrier being sensitized to the colder colors, the filter dyes serving to limit by absorption any passage of particular color component of light within the respective strata being present in the respective strata dependent upon their diffusive properties.

A specific sensitizing solution applied by myself for the production of three-strata sensitized mono-pack film of the type above described is as follows:

According to my process, I apply to the emulsion of the ordinary black and while monochromatic film a sensitizing solution which may, for the purpose of this disclosure, be considered a colloidal suspension in the form of dye particles in different sizes to provide stratification, and which incorporates in a dispersion medium of alcohol and water color sensitizing and filtering dyes of the following nature and in the following proportion:

For the warmer colors pinacyanol or cyanine, relatively large particles in alcohol;

For the cold colors, pinachrome and erythrosine

in aqueous solution, and Orthochrome T in alcoholic solution, the particles being relatively of small size;

For color filtering, rose bengal medium size particles and Rapid Filter Yellow of fine particles, both in aqueous solution.

I prefer to use the above specified color sensitizing and filtering dyes in the following quantities, with respect to the dispersing medium: I dissolve 1 g. of Pinorthol I, which comprises essentially of a mixture of Pinachrome and erythrosine and a slight amount of Rapid Filter Yellow, 1 g. of Rapid Filter Yellow and .4 g. of rose bengal, in order, 150 c. c. of water; I then add to the above solution 25 c. c. of 1/1000 alcohol solution of Pinacyanol and 25 c. c. of 1/1000 alcohol solution of Orthochrome T, with stirring, after which I add 200 c. c. of alcohol, and then add water until the solution makes up to 500 c. c., with stirring.

Upon applying the warm emulsion carrying a silver-salt to a paper in the sub-stratum of which the above solution incorporating color sensitizing and filter dyes has been introduced, a three-strata formation is imparted to such emulsion layer; in the stratum adjacent the sub-stratum we find the silver salt sensitized to record the color red and its derivatives by the reaction of the silver salt with the Pinacyanol or cyanine, while Rapid Filter Yellow and rose bengal are present in the emulsion of such strata to absorb any green or blue color component of light that might enter such stratum.

Directly above and adjacent the red-sensitized stratum we find a stratum the silver salts of which are sensitized to green by reaction with Pinorthol I and Orthochrome T, and the emulsion in such stratum has incorporated therein Rapid Filter Yellow and rose bengal to absorb the blue component of light or excess green component of light that enters such stratum.

In the third stratum formed above the green sensitized stratum we find the silver salt unaffected as to reaction with color sensitizing dyes, but within this stratum is found Rapid Filter Yellow, which absorbs excess of the blue component of light entering such stratum.

Since the reaction of the silver salt in the respective strata upon exposure has been described in detail in my copending application Serial No. 738,299, filed August 3rd, 1934, and assigned to the Omnichrome Corporation, assignee of this application, a brief description thereof will be given herein. Upon exposure of the film in a direction towards the emulsion, the blue component of light will affect the normally blue reacting unsensitized silver salt in the entrant stratum; the Rapid Filter Yellow serving to absorb all blue light not affecting the silver salt in such stratum and restrict its passage into the next adjacent stratum. The green component of light will be recorded in the middle stratum due to its effect to the reaction product of the green sensitizing dye with the silver salt in such stratum; and the rose bengal or minus green filtering medium will absorb the green color component of light not affecting the sensitized silver salt in such stratum and prevent its passage into the next adjacent stratum, while the Rapid Filter Yellow absorbs the blue component of light entering such stratum. Into the last stratum, the stratum containing silver salt sensitized to warmer colors, only the red and warmer color components of light will affect the same, the rose bengal and Rapid Filter Yellow present in such red sensitized stratum serving to absorb any green or blue components that might enter into such stratum.

It should be understood that although I have specified the use of a water-proof photographic paper for ordinary separate roll film or pack work this method of sensitizing a single layer for a mono-pack film with one solution at one time to provide a film capable of exposure from the emulsion face may be applied to glass carriers or celluloid carriers, the latter for motion picture work.

With respect to the dyes herein mentioned, following is the color index of each thereof as recognized and published under the Society of Dyers and Colourists Color Index; Pinacyanol, No. 808, cyanine, No. 806. Orthochrome T, No. 807, erythrosine, No. 772, rose bengal, No. 777, Rapid Filter Yellow, No. 640.

It is obvious that various changes and modifications may be made to the details of component applied and the process involved without departing from the general spirit of the invention as set forth in the appended claims.

I claim:

1. A method of forming a sensitized mono-pack film comprising uniformly coating a carrier with a homogeneous solution incorporating color sensitizing dyes and filter dyes of varying particle size and rate of diffusion and superimposing on such coating a layer of emulsion, and thus permitting the color sensitizing dyes and filter dyes to diffuse upwardly from the carrier into the emulsion.

2. A method of forming a sensitized mono-pack film comprising uniformly coating a carrier with a homogeneous solution incorporating color sensitizing dyes and filter dyes of varying particle size and rate of diffusion and superimposing on such coating a layer of emulsion, thus permitting the color sensitizing dyes and filter dyes to diffuse upwardly into the emulsion to provide a multi-strata formation, each stratum of which is affected to record different color aspects respectively in order from the carrier, from the warmer to the colder colors.

3. A method of forming a sensitized mono-pack film comprising uniformly coating a carrier with a homogeneous solution incorporating color sensitizing dyes and filter dyes of varying particle size and rate of diffusion and superimposing on such coating a layer of emulsion, thus permitting the color sensitizing dyes and filter dyes to diffuse upwardly into the emulsion to provide a three-strata formation, each stratum of which is affected to record different color aspects respectively in order from the carrier, from the warmer to the colder colors.

4. A method of forming a sensitized mono-pack film comprising uniformly coating a carrier with a homogeneous solution incorporating color sensitizing dyes and filter dyes of varying particle size and rate of diffusion and superimposing on such coating a layer of emulsion, thus permitting the color sensitizing dyes and filter dyes to diffuse upwardly into the emulsion to provide a three-strata formation, each stratum of which is affected to record different color aspects respectievly in order from the carrier from the warmer to the colder colors, the first stratum adjacent the carrier being affected to record red and its derivatives, the next adjacent stratum being affected to record green and its derivatives, the furthermost stratum being affected to record blue and its derivatives.

5. A method of forming a sensitized mono-pack film comprising uniformly coating a carrier with a homogeneous solution incorporating color sensitizing dyes and filter dyes of varying particle size and rate of diffusion and superimposing on such coating a layer of emulsion, thus permitting the color sensitizing dyes and filter dyes to diffuse upwardly into the emulsion to provide a multi-strata formation, each stratum of which is affected to record different color aspects respectively in order from the carrier, from the warmer to the colder colors, and each stratum being affected as to exclude the recordations of color accepted in the other strata.

6. A method of forming a sensitized mono-pack film comprising uniformly coating a carrier with a homogeneous solution incorporating color sensitizing dyes and filter dyes of varying particle size and rate of diffusion and superimposing on such coating a layer of emulsion, thus permitting the color sensitizing dyes and filter dyes to diffuse upwardly into the emulsion to provide a three-strata formation, each stratum of which is affected to record different color aspects, respectively in order from the carrier, from the warmer to the colder colors, and each stratum being affected as to exclude the recordations of color accepted in the other strata.

7. A method of forming a sensitized mono-pack film comprising uniformly coating a carrier with a homogeneous solution incorporating color sensitizing dyes and filter dyes of varying particle size and rate of diffusion and superimposing on such coating a layer of emulsion, thus permitting the color sensitizing dyes and filter dyes to diffuse upwardly into the emulsion to provide a three-strata formation, each stratum of which is affected to record different color aspects respectively in order from the carrier, from the warmer to the colder colors, the first stratum adjacent the carrier being affected to record red and its derivatives, the next adjacent stratum being affected to record green and its derivatives, the furthermost stratum being affected to record blue and its derivatives, and each stratum being affected as to exclude the recordations of color accepted in the other strata.

8. A method of producing a sensitized film comprising uniformly coating a carrier with a sub-stratum, incorporating in the sub-stratum a homogeneous solution containing a series of color sensitive dyes and filter dyes of varying particle size and rate of diffusion and superimposing upon the sub-stratum a layer of warm emulsion, whereby to permit the color sensitive dyes and filter dyes carried in the sub-stratum to diffuse upwardly into the emulsion to provide a multi-strata formation in the emulsion layer, each stratum of which is affected to record different color aspects.

9. A method of producing a sensitized film comprising uniformly coating a carrier with a sub-stratum, incorporating in the sub-stratum a homogeneous solution containing a series of color sensitive dyes and filter dyes of varying particle size and rate of diffusion and superimposing upon the sub-stratum a layer of warm emulsion, whereby to permit the color sensitive dyes and filter dyes carried in the sub-stratum to diffuse upwardly into the emulsion to provide a multi-strata formation in the emulsion layer, each stratum of which is affected to record different color aspects, and to exclude in such strata the color aspects recorded in the other strata.

10. A method of producing a sensitized film comprising uniformly coating a carrier with a sub-stratum, incorporating in the substratum a homogeneous solution containing a series of color sensitive dyes and filter dyes of varying particle size and rate of diffusion and superimposing upon the sub-stratum a layer of warm emulsion, whereby to permit the color sensitive dyes and filter dyes carried in the substratum to diffuse upwardly into the emulsion to provide a multi-strata formation in the emulsion layer, each stratum of which is affected to record different color aspects, the respective strata being affected to record different color aspects respectively from the warmer to the colder colors.

11. A method of producing a sensitized film comprising uniformly coating a carrier with a sub-stratum, incorporating in the sub-stratum a homogeneous solution containing a series of color sensitive dyes and filter dyes of varying particle size and rate of diffusion and superimposing upon the sub-stratum, a layer of warm emulsion, whereby to permit the color sensitive dyes and filter dyes carried in the sub-stratum to diffuse upwardly into the emulsion to provide a multi-strata formation in the emulsion layer, each stratum of which is affected to record different color aspects, the respective strata being affected to record different color aspects respectively from the warmer to the colder colors, and to exclude in such stratum the color aspects recorded in the other strata.

12. A method of producing a sensitized film comprising uniformly coating a carrier with a sub-stratum, incorporating in the substratum a homogeneous solution containing a series of color sensitive dyes and filter dyes of varying particle size and rate of diffusion and superimposing upon the sub-stratum a layer of warm emulsion, whereby to permit the color sensitive dyes and filter dyes carried in the sub-stratum to diffuse upwardly into the emulsion to provide a multi-strata formation in the emulsion layer, each stratum of which is affected to record different color aspects, the stratum first adjacent the sub-stratum being affected to record the color red and its derivatives, the next adjacent stratum being affected to record the color green and its derivatives, and the furthermost stratum being affected to record the color blue and its derivatives.

13. A method of producing a sensitized film comprising uniformly coating a carrier with a sub-stratum, incorporating in the sub-stratum a homogeneous solution containing a series of color sensitive dyes and filter dyes of varying particle size and rate of diffusion and superimposing upon the sub-stratum a layer of warm emulsion, whereby to permit the color sensitive dyes and filter dyes carried in the sub-stratum to diffuse upwardly into the emulsion to provide a multi-strata formation in the emulsion layer, each stratum of which is affected to record different color aspects, each stratum being affected to exclude in such stratum the color aspects recorded in the other strata.

HANS VON FRAUNHOFER.