Oct. 24, 1972 A. O. RAMSLEY ET AL 3,700,397

CAMOUFLAGED ARTICLE AND METHOD OF PRODUCING SAME

Filed May 6, 1969 2 Sheets-Sheet 1

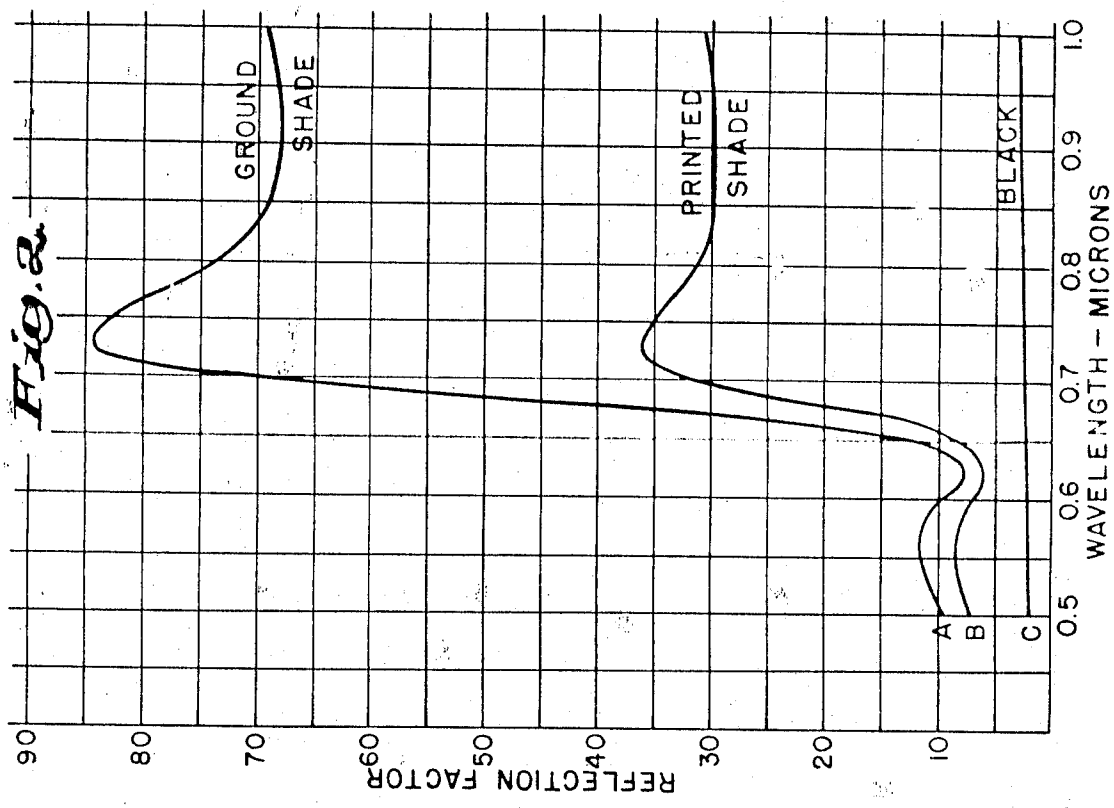


Fig. 2.

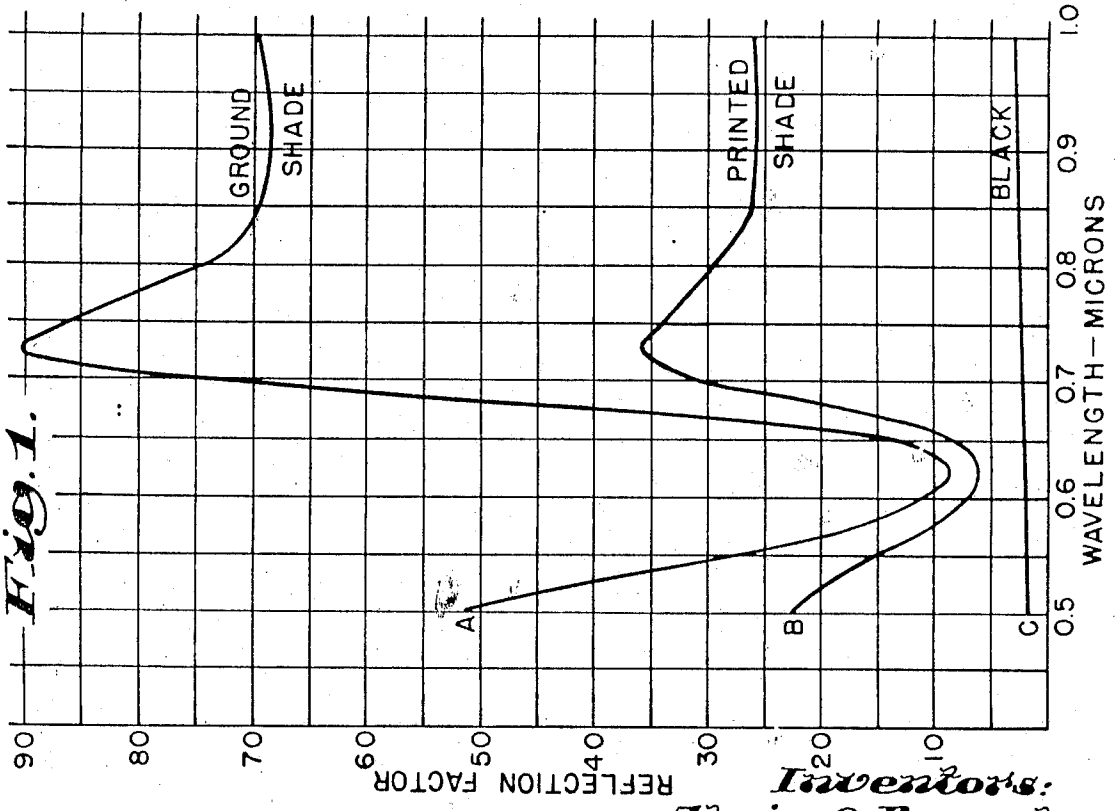


Fig. 1.

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CAMOUFLAGED ARTICLE AND METHOD OF PRODUCING SAME

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Fig. 5.



Fig. 4.

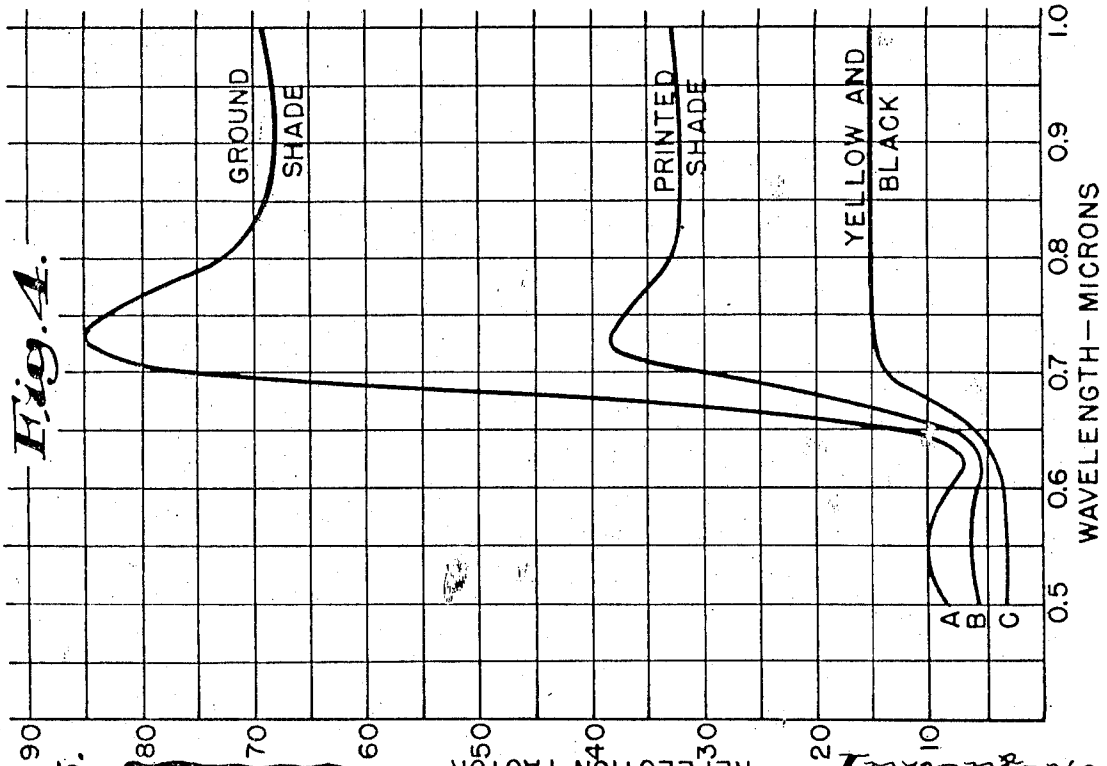
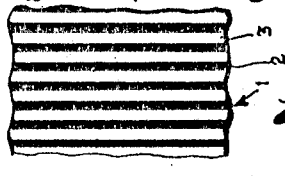


Fig. 3.



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CAMOUFLAGED ARTICLE AND METHOD OF PRODUCING SAME

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U.S. Cl. 8—4 10 Claims

ABSTRACT OF THE DISCLOSURE

Method of camouflaging dyeable materials against daylight or nighttime detection comprising dyeing the material with a dye composition producing a desired shade in the visible range of the spectrum and fluorescence in the near infrared range from 0.70 to 0.90 micron wavelength, and over-printing the dyed material with lines of a printing composition containing an energy absorbent pigment, such as carbon; and camouflaged articles produced by the method.

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to a camouflaged article and a method of producing the same. More particularly, the invention relates to camouflaged fabrics and camouflaged articles produced therefrom.

In the conduction of military field operations the camouflaging of the uniforms of soliders and of their shelters and other equipment has become very important to prevent detection thereof in the daytime by visual observation or by aerial photography employing infrared-sensitive photographic film which is particularly sensitive in the wavelength range of the spectrum from about 0.70 to about 0.90 micron and at night by electro-optical means, such as the so-called sniperscope, which usually employs radiations in the wavelength range of the spectrum from about 0.90 to about 1.20 microns.

Heretofore, camouflaging of military uniforms and other military equipment has been carried out primarily with respect to light in the visible range of wavelengths, generally from about 0.38 to about 0.70 micron. This has been done by dyeing or pigmenting fabrics and other materials with varicolored designs to simulate and blend with the surroundings in which the articles made of such fabrics or other materials are to be used, for example, jungle surroundings, rock formations, or other special situations. However, inasmuch as other methods of detection, such as aerial photography, employing radiations in the infrared region of the spectrum have been developed in recent years to supplement visual observation, conventional methods of camouflaging have become relatively ineffective.

Methods have been developed for dyeing fabrics or other dyeable materials with dyes which fluoresce strongly in the near infrared region of the spectrum, particularly at wavelengths from about 0.70 to about 0.90 micron. Such dyed materials blend well with backgrounds frequently encountered by the military forces, such as grass or earth. Materials dyed with such dyes do not show up in aerial photographs nearly so distinctly as materials dyed with conventional dyes, such as the olive green dyes that have been standard for military uniforms and other equipment for many years. However, these dyes generally have the disadvantage that they also reflect to a high degree in the wavelength range from about 0.90 to about 1.20 microns employed in electro-optical methods

of detection such as the sniperscope. Hence, uniforms and other articles dyed with dyes that fluoresce in the near infrared range are usually easily detected by means of the sniperscope at night. Separate uniforms for daytime and nighttime use could be issued to overcome this dilemma; but this would create a very severe logistic problem as well as greatly increased costs. It is, therefore, highly desirable to have a method of obtaining effective camouflage against detection by visual observation in the wavelength range from about 0.38 to about 0.70 micron, but at the same time providing in the same article effective camouflage against detection by aerial photography using film sensitive in the wavelength range from about 0.70 to about 0.90 micron and against detection by a sniperscope employing wavelengths in the range from about 0.90 to about 1.20 microns or even higher.

An object of the invention is to provide a method of obtaining effective camouflage of an article over the wavelength range of the electromagnetic spectrum from about 0.38 to about 1.20 microns.

A further object of the invention is to provide articles effectively camouflaged against detection by visual observation employing radiation in the wavelength range from about 0.38 to about 0.70 micron and by photographic and electro-optic methods employing radiation in the wavelength range from about 0.70 to about 1.20 microns, or higher.

Other objects and advantages will appear from the description of the invention hereinafter and the accompanying drawings wherein:

FIG. 1 is a graph of the reflection factor at various wavelengths of light for fabrics dyed and printed in accordance with Example 1 hereinafter.

FIG. 2 is a graph of the reflection factor at various wavelengths of light for fabrics dyed and printed in accordance with Example 2 hereinafter.

FIG. 3 is a plan view of a fabric dyed and printed in accordance with Example 2.

FIG. 4 is a graph of the reflection factor at various wavelengths of light for fabrics dyed and printed in accordance with Example 3 hereinafter.

FIG. 5 is a graph of the reflection factor at various wavelengths of light for fabrics first printed and subsequently dyed in accordance with Example 4 hereinafter.

The objects of the invention are accomplished in one embodiment of the invention by dyeing a fabric with a dye, or a mixture of dyes, which produces a fluorescent dyed surface on the fabric having a high reflection factor in the infrared wavelength range of the electromagnetic spectrum from about 0.70 to about 0.90 micron, drying the dyed fabric, printing the surface of the dyed fabric in a substantially uniformly distributed pattern, such as spaced lines, using a printing composition which is highly energy absorbent in the entire wavelength range involved, i.e. 0.38 to 1.20 microns, and drying the printed fabric. The dye is selected for the particular type of fabric and the printing composition is printed on the dyed fabric in such a pattern that the dyed and printed fabric has reflection factors of less than about 35% for radiant energy in the wavelength ranges from about 0.38 to about 0.70 micron and from about 0.90 to about 1.20 microns and a reflection factor for radiant energy of at least one wavelength in the wavelength range of from about 0.70 to about 0.90 micron which is not less than about 35%.

As will be readily apparent from an examination of the drawings, the reflection characteristics curves of materials embodying the invention include a distinct peak reflection factor in the wavelength range of from about 0.70 to about 0.90 micron. The occurrence of this peak

is essential to the effectiveness of the material as camouflage against infrared photography and, while it is desirable that the peak be substantially higher than the portions of the curves in the lower and higher wavelength ranges, the advantages of the invention are realized so long as the peak equals or exceeds 35% at some wavelength within the 0.70 to 0.90 micron range while the reflection factors in the lower and higher wavelength ranges are maintained below the 35% level, we have found that reflection factors in the 0.70 to 0.90 micron wavelength range which are at least 10% greater than the reflection factors in the lower and higher wavelength ranges are readily obtainable in accordance with the present invention as evidenced by FIGS. 1, 2, 4 and 5.

The objects may also be attained by first printing spaced lines on the surface of the fabric using the black pigment-containing highly energy-absorbent resin emulsion printing composition, drying the printed lines, then dyeing the printed fabric with a dye, or mixture of dyes, as aforementioned, thereby dyeing the fabric between the printed lines and obtaining a printed and dyed fabric having substantially the same light reflection characteristics as the above-described fabric which is first dyed and then printed with the black pigment-containing lines.

As a result of either of the above-described dyeing and printing or printing and dyeing procedures, a product is obtained which has reflection factors below about 35 percent in the visible range of the spectrum, i.e. at wavelengths of from about 0.38 to about 0.70 micron, a reflection factor not less than about 35 percent in at least one wavelength of the near infrared range of the spectrum, i.e. from about 0.70 to about 0.90 micron, and reflection factors below about 35 percent in the far infrared range of the spectrum, i.e. at wavelengths above about 0.90 micron and particularly between about 0.90 to about 1.20 microns. The net effect is that the reflection factor curve for the product, which is determined with a Beckman DU Spectrophotometer, is appreciably altered so that the product has lower reflection factors over the wavelength range of the spectrum from about 0.38 micron to about 1.20 microns, but retains effectively high reflection factors over the near infrared wavelength range from about 0.70 to about 0.90 micron. Thus, the product blends in well with backgrounds which fluoresce or reflect well in the near infrared range of the spectrum and is, therefore, effectively camouflaged against aerial photography, while not fluorescing or reflecting very strongly in the far infrared wavelength range above 0.90 micron and, therefore, being effectively camouflaged against detection by means of the sniperscope at night using wavelengths in the range from about 0.90 to about 1.20 microns. The material is also effectively camouflaged against visual observation by daylight or artificial light in the visible range when observed beyond certain distances, the printed lines blending in with the dyed portions of fabric between the printed lines at or beyond such distances. If, for example, the dye composition is selected to produce an olive drab color, then the product will blend well with all backgrounds with which the olive drab color normally blends despite the presence of the black pigment-containing lines, and beyond the selected distance for visual observation of the product. The overall result, therefore, is that the product is effectively camouflaged against detection during the daytime and nighttime over the spectral range from about 0.38 micron to about 1.20 microns or even higher wavelengths, provided the point of observation is more than a preselected distance from the product. The wider the printed lines are and the farther apart they are on the dyed background of the product, the farther away the point of observation of the product must be in order for it to be camouflaged. It is impractical in general to print lines narrower than about one-sixteenth inch wide separated about one-sixteenth inch apart on fabrics, although on other types of products, for example films, paper and the like, narrower lines and separations of the printed lines may be employed in order to reduce the distance from which observation may be carried out without a clear-cut detection of the product.

For the purposes of this application, the near infrared is defined as the range of wavelengths of the electromagnetic spectrum between about 0.70 and 0.90 micron, and the far infrared is defined as the range of wavelengths of the electromagnetic spectrum between about 0.90 and about 1.20 microns, or higher. The visible wavelength range is generally from about 0.38 to about 0.70 micron.

Also, for the purposes of this application, the reflection factor is defined as the sum of the normal reflection plus the contribution of fluorescence at a given wavelength of the electromagnetic spectrum when a specimen is illuminated by white light produced by a xenon lamp. The reflection factor is expressed in terms of percent of the light emerging from the surface compared with that which would be reflected by magnesium oxide at the given wavelength, using a Beckman DU Quartz Spectrophotometer for analyzing the light emerging from the respective surfaces at the various wavelengths of interest.

For the purposes of the present invention, Table 1 lists a number of dyes which have been found to fluoresce strongly in the near infrared range of the spectrum and are useful either alone or in combination with other dyes for obtaining the desired color effect in the visible range of the spectrum as well as fluorescence in the infrared. Table 1 also indicates the type of substrate material in the form of fabric with which each dye has been found to be particularly effective in terms of fluorescence in the near infrared. Other forms of the same substrate material would behave in a similar manner; for example, film, nonwoven fabric, molded or cast material, or the like can be dyed and printed in accordance with the invention.

TABLE 1

Dye	Color Index number	Chemical type	Type of substrate
Basic Blue 3	51005	Oxazine	Polyacrylic.
Basic Blue 4	51004	do	Do.
Basic Blue 7	42595	Triarylmethane	Do.
Basic Blue 9	52015	Thiazine	Do.
Basic Blue 12	51180	Oxazine	Do.
Basic Blue 26	44045	Triarylmethane	Do.
Basic Blue 36	None	do	Do.
Azure A	52005	Thiazine	Do.
Basic Green 1	42040	Triarylmethane	Do.
Basic Green 3	None	do	Do.
Basic Green 5	52020	Thiazine	Do.
Basic Violet 3	42555	Triarylmethane	Do.
Basic Violet 4	42600	do	Do.
Basic Violet 5	50205	Azine	Do.
Acid Blue 1	42045	Triarylmethane	Polyamide.
Acid Blue 3	42051	do	Do.
Acid Blue 7	42080	do	Do.
Acid Blue 9	42090	do	Do.
Acid Blue 63	None	Anthraquinone	Do.
Acid Green 3	42085	Triarylmethane	Do.
Acid Green 5	42095	do	Do.
Acid Green 16	44025	do	Do.
Acid Green 22	42170	do	Do.
Direct Blue 1	24410	Disazo	Do.
Direct Blue 3	23705	do	Do.
Direct Blue 8	24140	do	Do.
Direct Blue 14	23850	do	Do.
Direct Blue 15	24100	do	Do.
Direct Blue 21	23710	do	Do.
Direct Blue 22	24280	do	Do.
Direct Blue 23	24405	do	Do.
Direct Blue 25	23790	do	Cotton.
Direct Blue 27	23750	do	Polyamide.
Direct Blue 53	23860	do	Do.
Direct Blue 61	None	Not known	Do.
Direct Blue 106	51300	Dioxazine	Do.
Direct Blue 107	51315	do	Do.
Direct Blue 108	51320	do	Do.
Direct Blue 109	51310	do	Do.
Direct Blue 180	None	Azo	Do.
Disperse Blue 9	61115	Anthraquinone	Do.
Direct Violet 51	51325	Dioxazine	Do.

In general, it is desirable for the energy absorbent printing formulation, when dried, to have relatively low reflec-

tion factors in the wavelength range from about 0.38 to about 1.20 microns, for example, below about 20 percent, and preferably below about 10 percent.

The following examples are illustrative of the invention, while not being intended to be limitative thereof:

EXAMPLE 1

A polyacrylic fabric is dyed with a single fluorescent dye, Basic Blue 4 (Color Index Number 51004), by placing the fabric in a dye bath at 120° F. containing the following composition based on the weight of the fabric:

	Percent
Basic Blue 4	0.2
Sodium acetate	1.0
Acetic acid (56%)	1.0
Non-ionic surfactant ("Triton X-100," manufactured by Rohm & Haas Company)	1.0
Organic cationic retarder ("Retarder LAN," manufactured by E. I. du Pont de Nemours & Co., Inc.)	1.0
Demineralized water	95.8

The dye bath, which has a pH of about 5.0, is raised to its boiling temperature over a period of about 45 minutes. Boiling is continued for up to 2 hours or until the color is substantially removed from the dye bath. The fabric is removed from the dye bath and rinsed in demineralized water and dried.

The dried dyed fabric is placed on a flat surface and covered by a silk screen that produces straight lines one-sixteenth inch wide and spaced one-sixteenth inch apart. The pattern is produced by drawing a printing formulation having the following composition on the fabric by means of the screen:

	Grams
Carbon black dispersion	60.0
Acrylic padding emulsion ("Sherdye Padding Emulsion 1050," manufactured by Sherwin-Williams Company)	20.0
Triazine-formaldehyde condensate resin ("Aerotex Resin 23 Special," manufactured by American Cyanamid Company)	20.0
Sodium alginate	5.0
Water	95.0

The printed fabric is dried and the dried, printed, previously dyed fabric is analyzed on its printed surface with a Beckman DU Quartz Spectrophotometer using a xenon lamp as a source of white light to determine its reflection factors, as defined above and in accordance with the method described above. The results are shown in FIG. 1 in middle curve B, designated Printed Shade.

For comparative purposes, a piece of the dyed fabric after drying thereof but without any printed lines applied thereto is analyzed in a similar manner for reflection factor, the results thereof being shown in FIG. 1 in the upper curve A, designated Ground Shade. Also, a similar polyacrylic fabric in undyed form is printed solidly, rather than in the form of lines, over large enough area to enable analyzing the solid black surface for reflection factor, and analyzed in a similar manner to that employed with the printed fabric and the Ground Shade (dyed only) fabric. The results are shown in the lowermost C curve, designated Black.

It is apparent from FIG. 1 that the dyed and printed fabric produced in accordance with this example has a lower reflection factor throughout the range of the spectrum analyzed, namely at wavelengths of 0.5 to 1.0 micron, than the dyed only fabric; in other words, Printed Shade curve B is lower than Ground Shade curve A. The significant aspect of this example is that the Printed Shade sample retains a fairly high reflection factor in the wavelength range from 0.70 to 0.90 micron

while the reflection factor in the wavelength range above 0.90 micron has been greatly reduced, thus rendering the Printed Shade fabric difficult to detect either by infrared photography or by means of a sniperscope. And the alternate black lines and blue separations would be quite difficult to distinguish visually at viewing distances of 50 meters or more against a background with which the blue ground shade would blend well.

The foregoing example illustrates the principle of the method of the invention without reference to use in connection with camouflage in the visible range of the spectrum under field conditions.

EXAMPLE 2

A polyacrylic fabric is dyed with a combination of dyes by placing the fabric in a dye bath at 120° F. containing the following composition based on the weight of the fabric:

	Percent
Basic Blue 4 (C.I. No. 51004)	0.23
Basic Yellow 15	0.80
Basic Red 14	0.11
Sodium acetate	1.0
Acetic acid (56%)	1.0
Non-ionic surfactant ("Triton X-100," manufactured by Rohm & Haas Company)	1.0
Organic cationic retarder ("Retarder LAN," manufactured by E. I. du Pont de Nemours & Company, Inc.)	1.0
Demineralized water	94.86

The dye bath, which has a pH of about 5.0, is raised to its boiling temperature over a period of about 45 minutes. Boiling is continued for up to 2 hours or until the color is removed from the dye bath. The fabric is removed from the dye bath and rinsed in demineralized water and dried.

The dried, dyed fabric is silk-screen printed in the same manner as that described in Example 1. The printed fabric is analyzed with a Beckman DU Quartz Spectrophotometer in the same manner as the dyed and printed fabric of Example 1. The dyed, but unprinted, fabric was also analyzed as in Example 1. The results are shown in FIG. 2, the reflection factor of the dyed and printed fabric at various wavelengths being shown in the middle curve B, designated Printed Shade, while the reflection factors of the dyed, unprinted fabric at various wavelengths are shown in the upper curve A, designated Ground Shade. The lowermost curve C, designated Black, is similar to that in FIG. 1 and is obtained in the same manner as described in Example 1. FIG. 3 illustrates the surface appearance of the dyed and printed fabric. The fabric is generally represented by the numeral **1**, the printed lines by the numeral **2**, and the dyed portions of fabric between the printed lines by the numeral **3**.

It is apparent that the presence of non-fluorescent dyes in combination with a fluorescent dye in the dye bath does not substantially interfere with the behavior of the fluorescent dye in the infrared portion of the spectrum. Also, it is apparent that the printed black energy absorbent lines act in substantially the same manner when the ground shade includes a mixture of dyes as when it contains only one dye. The dyed and printed fabric of this example exhibits good camouflage characteristics both in daylight and at night since it retains effectively high fluorescence in the near infrared range, while its reflection factor in the far infrared is not so high as to be easily detectable with a sniperscope, and the black lines and lighter colored separations in the visible range blend sufficiently in daylight or artificial light at distances of 10 meters or less to prevent easy visual distinguishing of the fabric from a green background.

EXAMPLE 3

An acrylic fabric is dyed as in Example 2, except that the dye bath has the following dye formulation based on the weight of the fabric:

	Percent
Basic Blue 4 (C.I. No. 51004)	0.35
Basic Yellow 15	1.15
Basic Red 14	0.18
Sodium acetate	1.0
Acetic acid (56%)	1.0
Non-ionic surfactant ("Triton X–100," manufactured by Rohm & Haas Company)	1.0
Organic cationic retarder ("Retarder LAN," manufactured by E. I. du Pont de Nemours & Company, Inc.)	1.0
Demineralized water	94.34

The resultant Ground Shade approximately matches Olive Green 106 when viewed under a standard shade lamp operating at a correlated color temperature of 7500° K.

The dyed fabric is silk-screen printed in the same manner as in Examples 1 and 2, except using a printing formulation having the following composition:

	Grams
Carbon black dispersion	10.0
Iron oxide yellow	50.0
Acrylic padding emulsion ("Sherdye Padding Emulsion 1050," manufactured by Sherwin-Williams Company)	20.0
Triazine-formaldehyde condensate resin ("Aerotex Resin 23 Special," manufactured by American Cyanamid Company)	20.0
Sodium alginate	5.0
Water	95.0

This printing formulation produces lines of an olive drab shade which blend well with the olive green Ground Shade in the visible range of the spectrum. As seen in FIG. 4, the reflection factor curve for the dyed fabric is shown in curve A, and the reflection factor curve for the dyed and printed fabric in curve B. Curve C is determined in the same manner as curve C of FIG. 1. The dyed and printed fabric (curve B) shows behavior in the infrared range of the spectrum similar to that of the dyed and printed fabric of Example 2, although the reflection factor curve for the printed on printing formulation (curve C) is appreciably higher in the infrared than the reflection factor curves for the black carbon pigment only in FIGS. 1 and 2. The dyed and printed fabric of this example provides good camouflage against infrared photography in the near infrared range, against detection with a sniperscope using the far infrared range, and against visual observation even close up in an environment with which olive green shades would blend well because the printed on lines blend well with the ground shade separations, providing an almost true solid shade throughout the fabric surface.

EXAMPLE 4

Using the same two coloring formulations as Example 3, a polyacrylic fabric is first screen printed with the printing formulation with one-sixteenth inch wide lines separated one-sixteenth inch apart and thereafter dyed with the dye formulation. The reflection factor curves for the resulting fabric are shown in FIG. 5, curve B representing the printed and dyed fabric, curve A representing the same fabric dyed only with the dye formulation, and curve C representing the dried printing formulation, this curve being determined in the same manner as curve C of FIG. 1. It is apparent that the printed and thereafter dyed fabric shows substantially the same reflectance characteristics in the infrared as the fabric which is first dyed and thereafter printed, as in Example 3. Also, because of the close similarity of the olive green shades of the dyed portions and the printed portions of the fabric, the printed and dyed fabric presents a substantially solid shade appearance in the visible range of the spectrum and is well camouflaged in an environment which blends well with olive green and furthermore is not easily detected by infrared photography using the near infrared or by means of the sniperscope using the far infrared portion of the spectrum. It is apparent, therefore, that the printing on of the black energy absorbing pigment in the printing formulation may be done prior to dyeing as well as subsequent to dyeing of the fabric in the separations between the lines of energy absorbing pigment with substantially equally effective camouflage results.

Although in the above examples carbon served as the black energy absorbent pigment component of the printing formulations, it is to be understood that other highly energy absorbent pigments may be similarly employed. For example, black iron oxide may be used and is quite effective. There are numerous other black or very dark pigments which may be similarly used, provided they do not have a tendency to degrade the substrate material. Examples of other such pigments are certain black metal oxides, such as tin oxide, cupric oxide, lead oxide, silver oxide, cobalt oxide, vanadium oxide, chromium oxide, germanium oxide, and molybdenum oxide, certain black metal sulphides, such as cuprous sulphide, cupric sulphide, lead sulphide, silver sulphide, cobalt sulphide, molybdenum sulphide, nickel sulphide, vanadium sulphide, and many other black or very dark crystalline or amorphous substances. Elemental silicon may also be used as the energy absorbent pigment.

In the above examples, acrylic or polyacrylic fabrics were used as the substrate materials which were dyed and printed or first printed and then dyed in accordance with the invention. However, it is to be understood that the invention is applicable to any substrate material which is dyeable by dyes which fluoresce in the infrared region, especially in the near infrared, when used in combination with the selected substrate material. Furthermore, the substrate material may be in any suitable form for the purpose it is designed to serve.

It is also to be understood that the printed lines are not required to be perfectly straight to serve the camouflaging purposes of the invention. It may even be highly desirable in certain instances for the enhancement of camouflage against certain types of background to have the lines printed in selected curved or wavy designs. The important consideration is to produce in a camouflaged article the maximum degree of blending in with the background environment in which the article is to be used, the blending in being as nearly complete as possible over the range of wavelengths from about 0.38 to about 1.20 microns or even higher so that the article may be employed in the daylight or at night without being in serious jeopardy of detection by visual observation, by infrared photography, or by sniperscope or other electro-optical means. This may even be accomplished by dyeing and printing a fabric with a pattern of dots or in a checkerboard design or by other means of distributing the printed on portions of black pigment-containing composition relatively uniformly over the entire area of the material.

The method of the invention is very useful in producing camouflage effects on fabrics as well as other forms of materials used by the Armed Forces. It is especially useful in the production of uniforms which are required to be worn in combat situations both in the daytime and at night since uniforms can now be made in accordance with this invention which will be very difficult to detect by visual observation in the daytime by sunlight or at night by artificial light, by aerial photography using film that is sensitive in the near infrared region from about 0.70 to about 0.90 micron in wavelength, or by means of the sniperscope at night by irradiating the uniform with infrared energy of from about 0.90 to about 1.20 microns wavelength. Thus, a soldier wearing a uniform made in accordance with the present invention will have greatly

improved chances of not being detected by the enemy and, therefore, much improved chances of survival under combat conditions. When applied to tentage, the invention greatly reduces the chances of detection by an enemy of positions where troops or equipment and supplies are sheltered, particularly by means of infrared aerial photography, thus reducing the losses of troops, equipment and supplies due to bombings of shelters.

We wish it to be understood that we do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

We claim:

1. Method of treating a dyeable material to minimize detection thereof by visual observation or by infrared detection means including infrared photography and sniperscope means which comprises the steps of:

(a) dyeing said material with a dye composition which imparts to said material fluorescence in the wavelength range from about 0.70 to about 0.90 micron producing a reflection factor of at least about 35% for at least one wavelength of radiant energy in said wavelength range,

(b) drying said material after said dyeing thereof,

(c) printing selected portions of said dyed and dried material with a printing composition which when dried has reflection factors below at least about 35% for radiant energy in the wavelength range from about 0.38 to about 1.20 microns, said selected portions being substantially uniformly distributed over the entire area of said material and being of a width of at least about 1/16 inch and being spaced at least about 1/16 inch apart to provide a printed and dried material having reflection factors below about 35% for radiant energy at all wavelengths in the wavelength ranges from about 0.38 to about 0.70 micron and from about 0.90 to about 1.20 microns and a reflection factor not less than about 35% for radiant energy of at least one wavelength in the wavelength range from about 0.70 to about 0.90 micron, and

(d) drying said printed material.

2. The method of claim 1 wherein said selected portions comprise substantially uniformly spaced lines of substantially uniform width.

3. The method of claim 2 wherein said lines are about 1/16" in width and are spaced about 1/16" apart.

4. The method of claim 1 wherein said printing composition comprises a radiant energy absorbent black pigment.

5. The method of claim 4 wherein said pigment comprises carbon.

6. The method of claim 1 wherein the steps of printing said material and drying said printed material are carried out prior to the steps of dyeing said material and drying said dyed material.

7. A treated article having selected portions of the surface of said article having reflection factors below about 35% for radiant energy at all wavelengths in the wavelength ranges from about 0.38 to about 0.70 micron and from about 0.90 to about 1.20 microns and the remaining portions of the surface of said article having a reflection factor not less than about 35% for radiant energy of at least one wavelength in the wavelength range from about 0.70 to about 0.90 micron, said selected portions being substantially uniformly distributed over the surface of said article, whereby said article is effectively camouflaged against visual detection, photographic detection in the visual light and near infrared ranges of the electromagnetic spectrum, and electro-optical detection in the far infrared range thereof.

8. A treated article according to claim 7 wherein said selected portions of the surface of said article are printed with a material having low reflection factors for radiant energy at all wavelengths in the wavelength range from about 0.38 to about 1.20 microns and said remaining portions of said surface are dyed with a dye composition which imparts to said surface fluorescence in the wavelength range from about 0.70 to about 0.90 micron and having a high reflection factor for radiant energy of at least one wavelength in said wavelength range.

9. A treated article according to claim 7 wherein said treated article is textile fabric.

10. A treated article according to claim 7, wherein said treated article is film.

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U.S. Cl. X.R.

8—1 XA, 14, 17, 18, 62; 117—33.5 T, 33.5 R