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INFRA RED REFLECTING YARNS AND FABRICS

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This invention relates to textile yarns and fabrics, more particularly to the use of blends of colors to reflect infra-red radiation. The present application is a continuation-in-part of copending application Serial No. 521,419, filed July 11, 1955, entitled "Textile Yarns and Fabrics," now abandoned.

It is an object of the invention to produce yarns and fabrics having a high resistance to penetration by the heat rays of the sun.

Another object of the invention is to produce fabrics which, whilst preserving such resistance to penetration, are also of an improved structure and appearance as will appear more fully below.

With suitable variation as to weave and weight, and features such as count of yarn and nature of fibers, and with either plain or fancy yarns, the improved fabrics of the present invention are useful inter alia for the making of clothes for tropical wear, and for many other similar purposes. It is possible, for example, to produce fabrics of synthetic fibers, having substantially the appearance of wool or worsted fabrics so that, for example, a relatively lightweight heat-resisting dress fabric, suiting or coat fabric can have the general appearance of being heavier, heat-retaining fabric. The invention also allows of fabrics being produced which are useful as heat-resisting tent cloth or awning material, especially for tropical climates.

According to this invention, a yarn is made up from a mixture of fibers which respectively are of the primary colors of the solar spectrum, each color being obtained by the use of dyestuffs known to offer some degree of reflectance to infra-red rays, namely red, yellow and blue; or red, green and blue, and so that such fibers are present in the respective colors throughout the whole of the yarn in such proportions as to give a reflectance approximating to that of white when tested by infra-red photography.

These proportions cannot be stated precisely as applying to all cases, since man-made colors cannot equal the purity and regularity of the colors in the solar spectrum and, moreover, it is impossible for color makers to guarantee identity of shade and infra-red reflectance at all times.

A fabric made from a yarn of this kind has a degree of heat resistance substantially equal to that of white when subjected to direct radiant heat and it may also be given a very pleasing appearance. In some cases a tweed-like effect is obtainable in a fabric produced from spun man-made fibers. Other novel and attractive effects are obtainable according to the structure of the yarn and the fabric.

The improved yarns may be produced in various ways. They may for examp'e be made from dyed natural fibers or from dyed synthetic fibers of staple length, or from mixtures of natural and synthetic fibers.

In one mode of carrying out the invention, batches of viscose or other cellulose derivative are dyed to the required three colors and then squirted or extruded in the usual way, the resulting filaments are cut to staple length

and the three batches of cut fibers are then thoroughly mixed together in the required proportions. The mixture is then spun into yarn. If desired, natural fibers of the same color as one or more of the batches of synthetic fibers may be introduced into the mixture before spinning, so long as the combined colors in the total mixture are such as to give the required high-reflectance to infra-red rays.

In another mode of operation, batches of loose fibers or cut filaments of staple length are dyed in the respective colors, and mixed in the required proportions before being spun into yarn.

The aim in both these cases is to have in the finished fabric, at all parts of the fabric, closely associated fibers of the several primary colors in the proportions giving a reflectance to infra-red approximating closely to that of white. The dyes used must be such as will themselves reflect infra-red rays. Preferably, the fibers dyed therewith are deep dyed.

Any known type of weave may be adopted, according to the effect desired and the fabric may be finished (other than by dyeing) in any way necessary for particular uses of it. The invention is equally applicable to the making of fabrics from mixtures of materials (e.g. cotton and man-made fibers, or wool and man-made fibers) as to the making of fabrics of uniform materials, whether of vegetable, animal, artificial or synthetic origin. Felted fabrics may also be produced according to this invention.

In a particular example of the improved fabric, by way of illustration, the fabric is a 54 x 44 cloth, woven on a 2 x 2 box loom from spun viscose yarns of 12s cotton count both in the warp and weft which yarns have been made up from a mixture of cut fibers obtained from three dope-dyed batches of viscose. The proportions of color are approximately:

	Percent
Red	25
Green	25
Blue	50

The proportions of the three primary colors forming white light in the solar spectrum, ascertained as a result of tests carried out at the Manchester (England) College of Science and Technology are:

	X	Y	Z	Dominant Wave Length	Lumen	Approximate Proportions of Energies (Watts)
						Percent
Red	.67	.33	0	612	0.30	24.7
Green	.21	.71	.08	535	0.59	25.9
Blue	.14	.08	.78	470	0.11	49.4

X, Y and Z are the points of a triangle within which any particular color is plotted. The chart containing this diagram is that produced by the Commission Internationale de l'Eclairage in 1931, being the accepted standard of color definition used in photometry. The trichromatic coordinates gives the position of the color within the triangle.

The relative proportions of the dyed yarns used is dependent upon the depth of colors available and their degree of resistance to the penetration of the infra-red rays, as will readily be appreciated by the skilled artizan.

Before spinning into yarn, the viscose or other dyed fibers may have white fibers added to the mixture, when light pastel shades are required.

In order to provide fabrics in a range of colors required by the trade, the preparation of the fibers for spinning may be varied without sacrifice of the heat-resisting qualities.

Thus, grey, grey-green, grey-blue, brown and a range of mixture shades can be produced by mixing appropriate amounts of the three primary colors together. The absorption will fall to zero beyond the absorption bands, whereas in a mixture of black and white or in a solid brown, khaki or tan there will still be strong absorption in the infra-red.

The following table gives various examples of mixtures of said primary colors which, when made into textile materials, produce the desired results of the invention.

Blue	Green	Yellow	Red
Percent	*Percent*	*Percent*	*Percent*
40	30	--------	30
30	40	--------	30
40	15	15	30
35	--------	35	30
42	34	--------	24

In practice, grey and other colored fabrics made under the three-color specification are almost as good as white, while similar shades of grey obtained by black-white mixing, show heat absorption which is more than 50% greater, being almost as bad as black.

The three primary colors of the sun's spectrum—blue, yellow and red or blue, green and red—may be varied in the mixing of the dyed fibers before spinning the yarn. By a slight adjustment in the proportions, a large range of attractive colorings can be obtained suitable for tropical wear or for summer suitings in European countries. A tan or khaki shade can be obtained by reducing the proportions of blue and increasing the green and red. Yellow may be substituted for green. For at least part of the green, the equivalent of blue and yellow may be used.

What is claimed is:

1. A textile fabric wherein said fabric is woven from spun yarns consisting of a blend of the primary colors of the solar spectrum and which is essentially of the colors red, blue, and at least one color taken from the class consisting of yellow and green, in such proportions as to give a reflectance of infra-red rays approximating that of white.

2. A textile fabric wherein said fabric is woven from spun yarns consisting of a blend of the primary colors of the solar spectrum and which is essentially of the colors red, blue, and at least one color taken from the class consisting of yellow and green, in such proportions as to give a reflectance of infra-red rays approximating that of white, said fabric being multi-colored.

3. A textile fabric wherein said fabric is woven from spun yarns consisting of a blend of the primary colors of the solar spectrum and which is essentially of the colors red, blue, and at least one color taken from the class consisting of yellow and green, in such proportions as to give a reflectance of infra-red rays approximating that of white, the proportions of said blended colors being approximately as follows:

	Percent
Blue	30–50
Green	25–40
Red	20–30
Yellow	15–35

4. A textile fabric wherein said material is woven from spun yarns consisting of a blend of the following primary colors of the solar spectrum in approximately the stated proportions:

	Percent
Blue	40
Green	30
Red	30

and having a reflectance to infra-red rays approximating that of white.

5. A textile fabric wherein said material is woven from spun yarns consisting of a blend of the following primary colors of the solar spectrum in approximately the stated proportions:

	Percent
Blue	30
Green	40
Red	30

and have a reflectance to infra-red rays approximating that of white.

6. A textile fabric wherein said material is woven from spun yarns consisting of a blend of the following primary colors of the solar spectrum in approximately the stated proportions:

	Percent
Blue	50
Green	25
Red	25

and having a reflectance to infra-red rays approximating that of white.

7. A textile fabric wherein said material is woven from spun yarns consisting of a blend of the following primary colors of the solar spectrum in approximately the stated proportions:

	Percent
Blue	42
Green	34
Red	24

and having a reflectance to infra-red rays approximating that of white.

8. A textile fabric wherein said material is woven from spun yarns consisting of a blend of the following primary colors of the solar spectrum in approximately the stated proportions:

	Percent
Blue	35
Yellow	35
Red	30

and having a reflectance to infra-red rays approximating that of white.

9. The method of making a textile yarn wherein the yarn is made up from fibers which respectively are of the primary colors of the solar spectrum, each color being obtained by the use of dyestuffs known to offer some degree of reflectance to infra-red rays (i.e. red, blue and a color taken from the class consisting of yellow and green) and so that throughout the whole of the yarn fibers of the respective colors are present in proportions such as to give a reflectance approximating to that of white when tested by infra-red photography.

10. A textile material having filaments of red, green and blue in such proportions as to totally reflect substantially all of the infra-red rays of the solar spectrum.

11. A textile material having filaments of red, green and blue in such proportions as to totally reflect substantially all of the infra-red rays of the solar spectrum, said red being the smallest constituent and said blue being the largest constituent.

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