July 3, 1962 E. ROHNER 3,042,476

METHOD FOR DUPLICATING THE DYE OF AN ORIGINAL ON A DYE CARRIER

Filed March 21, 1960 5 Sheets-Sheet 1

Fig. 1

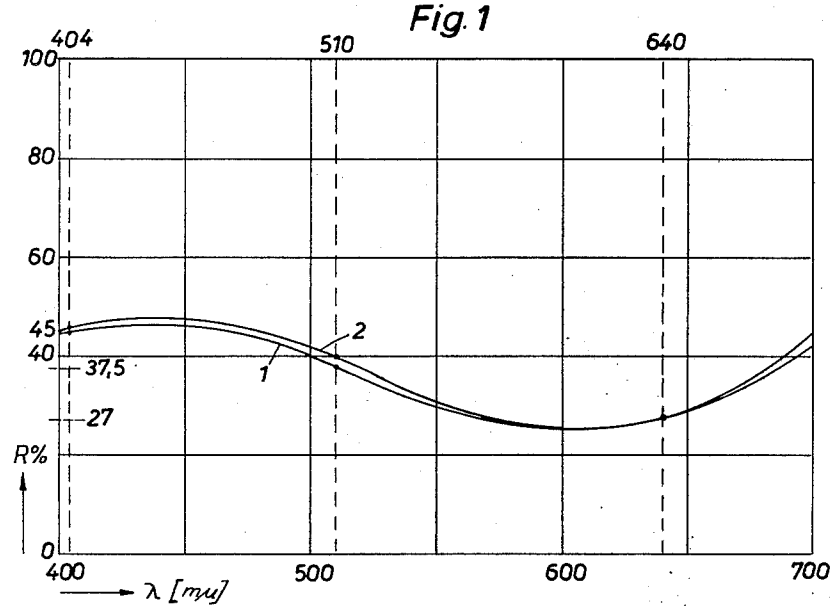
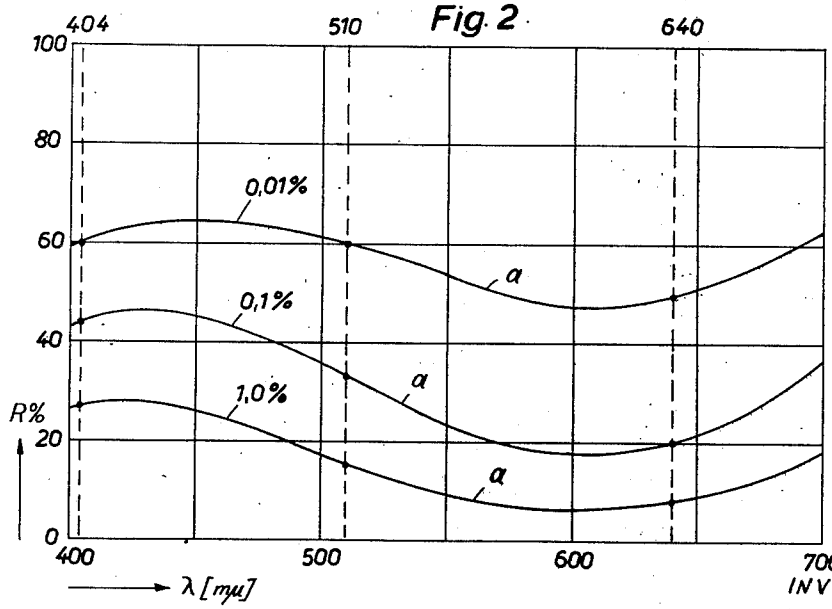


Fig. 2



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Fig. 3

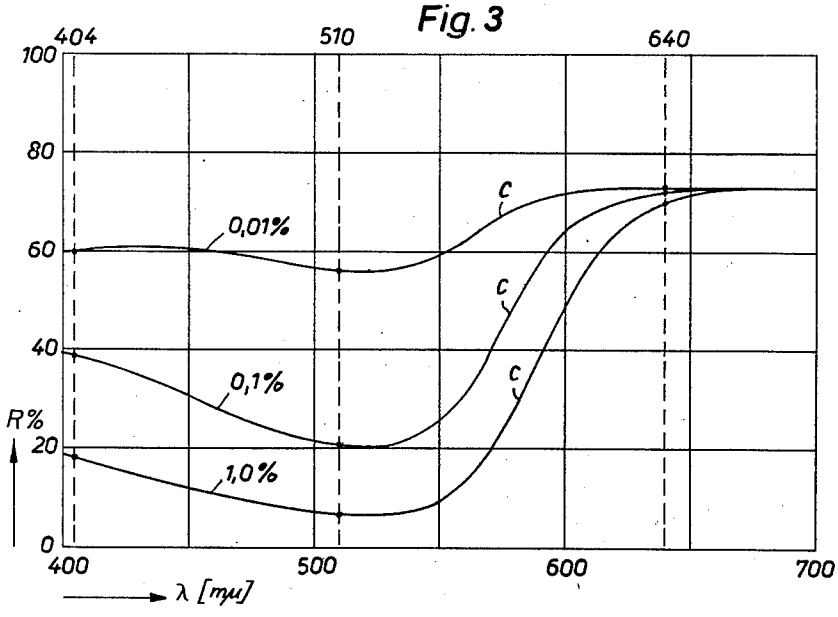
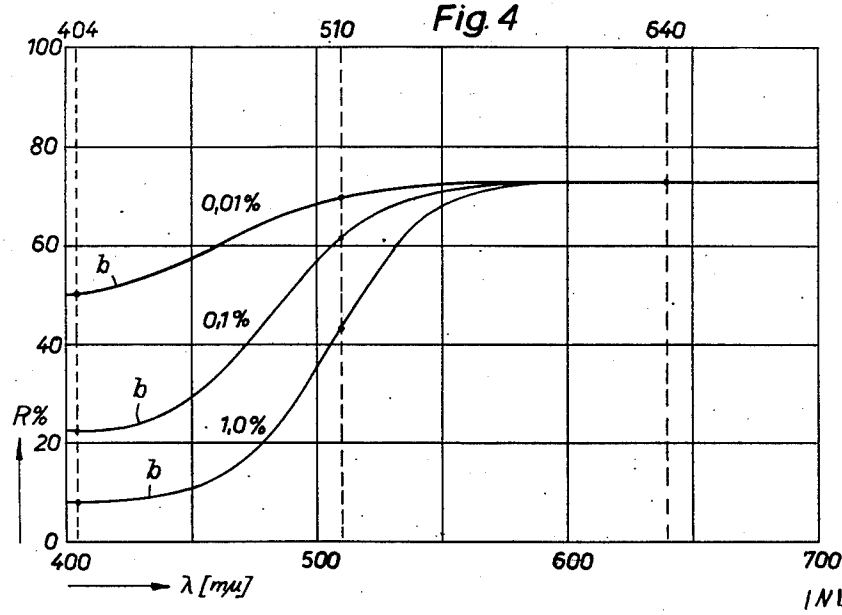


Fig. 4



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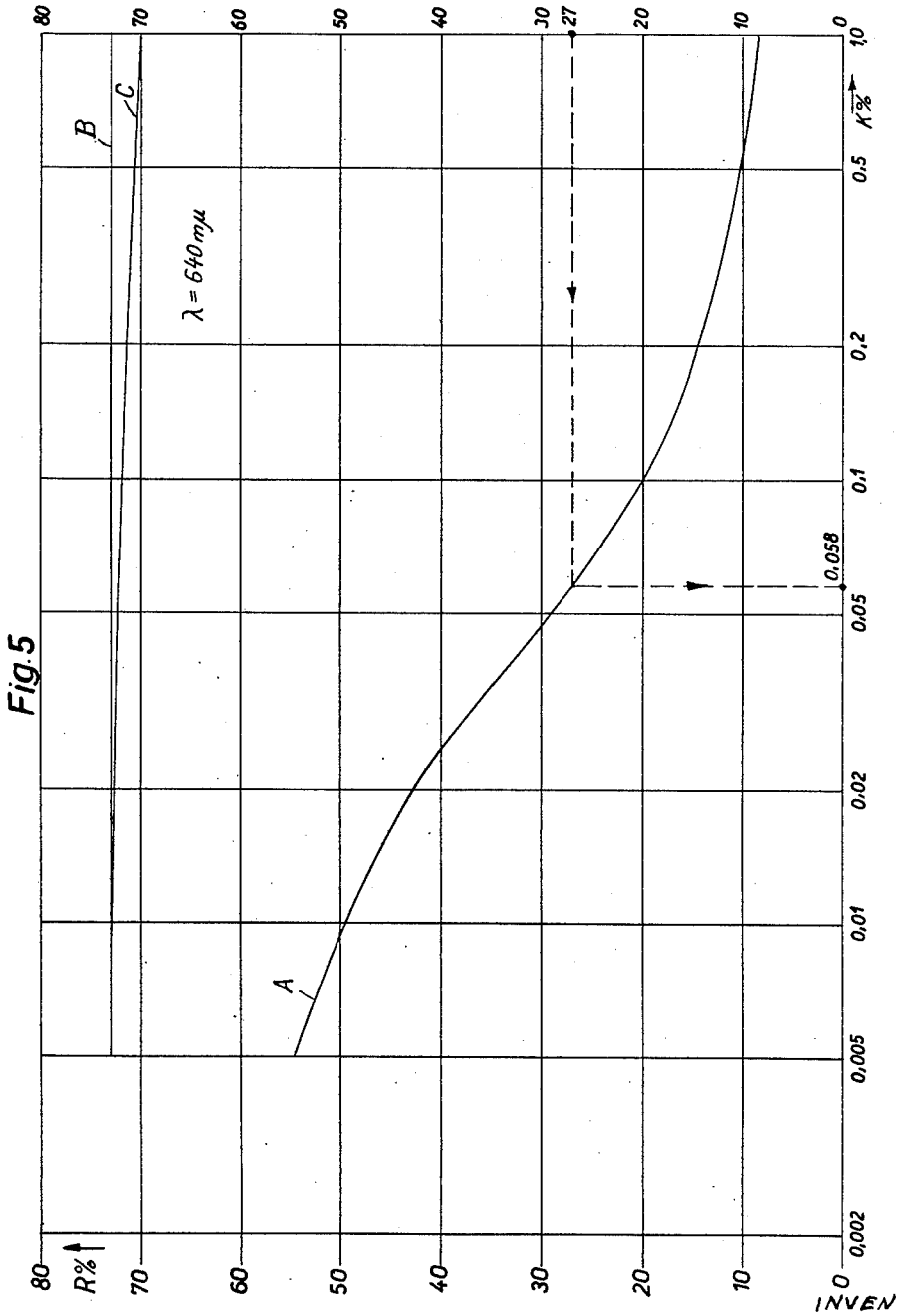


Fig.5

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METHOD FOR DUPLICATING THE DYE OF AN ORIGINAL ON A DYE CARRIER

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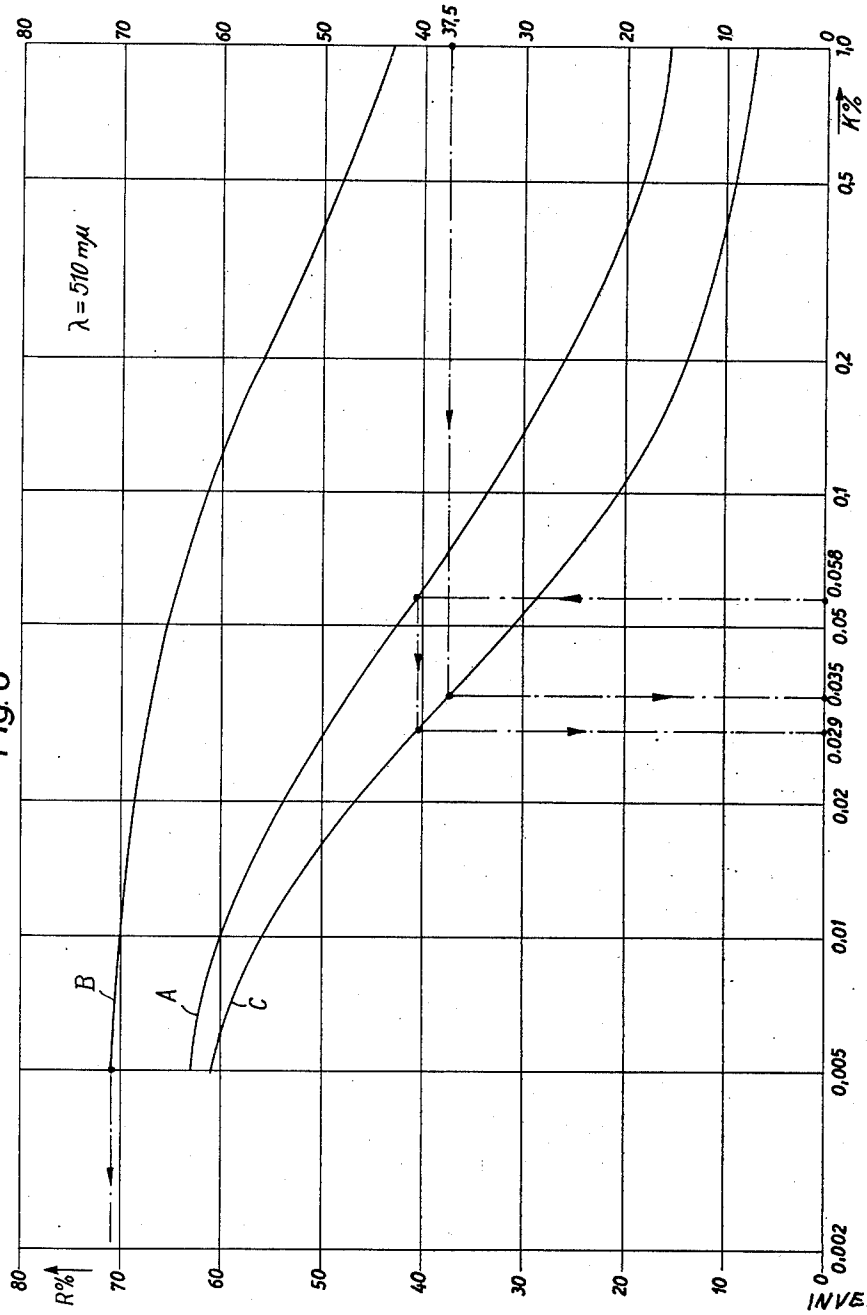


Fig. 6

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METHOD FOR DUPLICATING THE DYE OF AN ORIGINAL ON A DYE CARRIER

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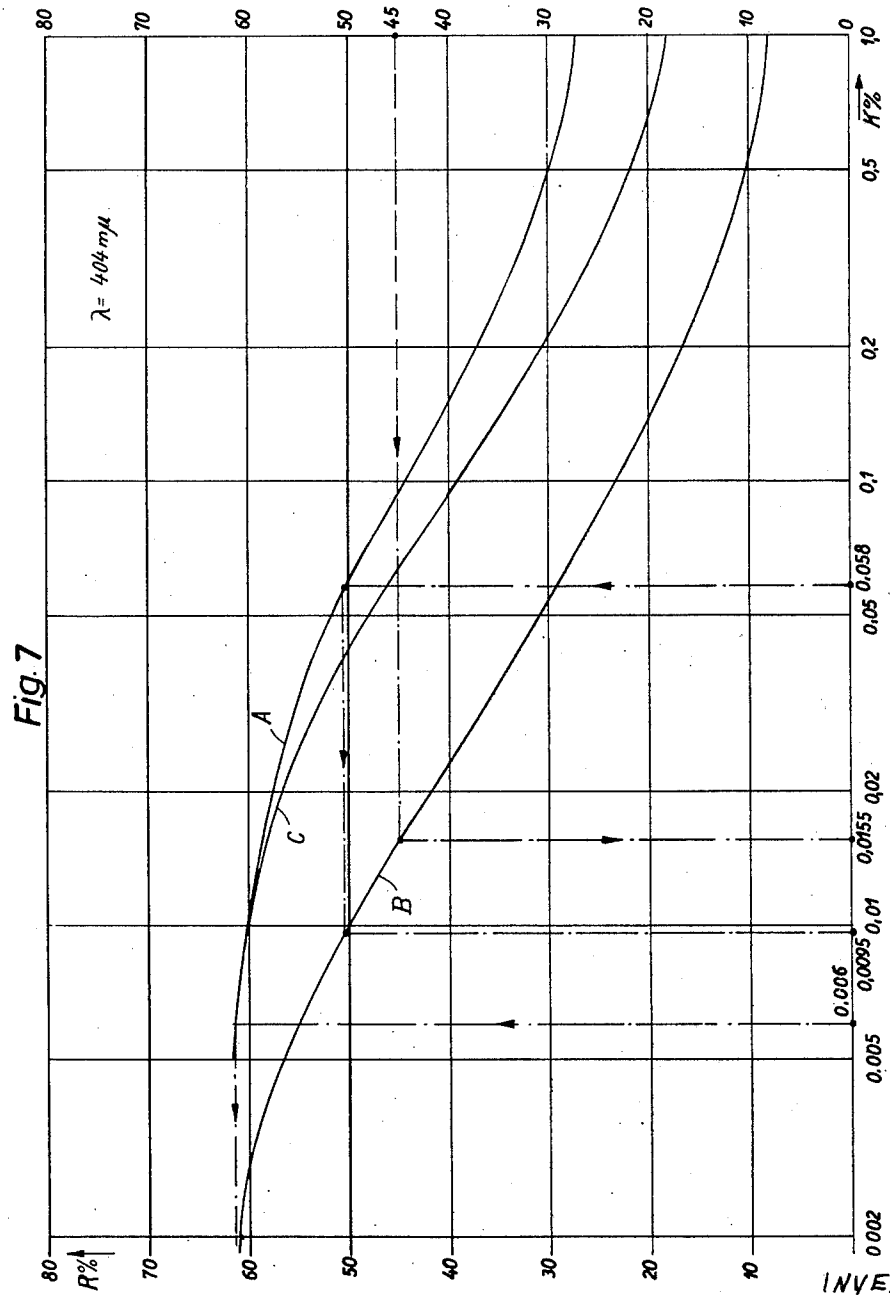


Fig. 7

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METHOD FOR DUPLICATING THE DYE OF AN ORIGINAL ON A DYE CARRIER

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3 Claims. (Cl. 8—25)

It is known that when duplicating the dye mixture of an original, the requisite recipes are determined by subjective, visual methods. In such a method, mixing preferably proceeds from a known recipe which is visually as similar to the original as possible. The desired dye recipe which most closely approximates the original, is obtained by this method after a time-consuming series of color corrections.

It is further known that the requisite dye recipes can be determined graphically or computationally by methods based on the Kubelka-Munk law. This law is, however, of only limited validity when applied to practical dyeing processes, since the factors which greatly influence the variable characteristics of the various dye carriers, for example, textiles, plastics, paper, etc., are not considered in the computations. In addition, the variations of the conditions in dyeing technology cannot be taken into consideration with sufficient accuracy. Both these considerations, as well as the considerable amount of computation necessary, make the practical utility of these methods questionable, so that a successful production, which more or less resembles the original, is achieved only after tedious correction by highly skilled personnel.

The method of the present invention avoids the disadvantages of the visual as well as of the graphic and computational methods of recipe determination for duplication of dye exemplars.

The method according to present invention comprises applying a number of primary-color dyestuffs, in a plurality of dyestuff concentrations to the same dye carrier to be dyed, determining from these samples the spectral re-emission curves, determining the spectral emission curve of the original dye mixture, selecting from the spectral re-emission curve of the primary-color dyes the number of wave-lengths corresponding to the number of the primary-color dyes, wherein the ratio of the re-emission of one primary-color dye to the ratios of the re-emissions of the other primary-color dyes is a minimum, tracing graphically for these wave lengths the re-emission values of the primary-color dyes as a function of the dye-bath concentration, determining from these graphs, the bath concentration of the individual dye components of the dye mixture at the re-emission values corresponding to the wave-lengths of the original dye mixture, mixing the dye components in the determined concentration, and dyeing the dye carrier with this mixture of dyes.

In the novel method of the present invention, the dye recipes can be determined with a high degree of accuracy within a few minutes, and the subsequent dyeing process can be considerably shortened as compared with previously known methods. This results in a better utilization of the dyeing machines and a correspondingly increased productivity.

The invention will be more fully described with reference to the accompanying drawings showing diagrams which are required for carrying out the individual steps of the present invention.

FIGURE 1 shows the spectral re-emission curves of the original dye and the duplicate, drawn as function of the wavelength.

FIGURES 2, 3 and 4 show each the spectral re-emission curves for a primary-color dye at various dyestuff concentrations.

FIGURES 5, 6 and 7 show the concentration curves of the three primary-color dyes, each at a chosen wavelength.

The following example will be based on the assumption that the original dyestuff which is to be duplicated contains the primary-color dyes, blue, scarlet, and yellow. The spectral re-emission curve No. 1 of FIGURE 1 is known. The above-mentioned primary-color dyes are first applied to the dyeable dye carrier material in various concentrations (in the example of the present invention, according to FIGS. 2 to 4 incl., in concentrations of 0.01%, 0.1% and 1.0%). It is advantageous to carry out this dyeing operation within a concentration range of 0.005% to 2.0%. From these samples, the curve of the re-emission, R, in percent, carried over the wave-length of the spectral re-emission curve (FIGS. 2–4 incl.) can be determined, whereby FIG. 2 shows the re-emission curves *a* for the blue primary-color dyestuff, FIG. 3 shows the re-emission curves *c* for the primary-color dye-stuff scarlet, and FIG. 4 the re-emission curves *b* for the primary-color dyestuff yellow. From these emission curves, *a*, *b*, *c*, a number of wavelengths are chosen which represent the number of these basic colors, and by comparison of these three graphic representations, 2 to 4 incl., those wavelengths are chosen, in which the proportion of one primary-color dye to the other primary-color dyes is at a minimum. It is evident from FIGS. 2 to 4 incl. that the re-emission of the primary-color dyestuff, blue, is at a minimum with respect to the re-emissions of the other two primary-color dyestuffs, yellow and scarlet at λ 640 mμ. It is to be noted, that the choice does not depend on the smallest absolute value of the blue primary-color dyestuff (this is approximately at λ 600 mμ), but upon the ratio of this re-emission to the re-emissions of the other dyestuffs. It may also be seen from FIGS. 2–4 incl. that the minimum ratio for the primary-color dyestuff scarlet is at λ 510 mμ, and for the primary-color dyestuff yellow, at λ 404 mμ.

Now the three wave-lengths of the re-emission values of the three basic dyes, chosen by the above method, can be represented graphically as a function of the dyestuff concentration, K. This can be accomplished most advantageously by logarithmic means, as in the illustrated example. FIGS. 5, 6 and 7 show the concentration curves A, for blue, B, for yellow, and C for scarlet at the respective wave-lengths λ 640 mμ, λ 404 mμ and λ 510 mμ. The recipe for the duplicating dye mixture can now be determined from these concentration curves.

According to the re-emission curve of the original dye, as shown in FIG. 1, a total re-emission of 27% is required at wave-length λ 640 mμ. Since, as shown in FIGS. 2–4 incl., the primary-color, blue, is the sole decisive factor, the concentration K which represents a re-emission R equal to 27% is sought in curve A of FIG. 5, and yields a concentration for blue of 0.058%. According to the curve 1 of FIG. 1, the dye sample has a re-emission value at wave-length λ 510 mμ of 37.5%, and as shown by FIGS. 2–4 incl., the prime factor in the re-emission at this wave-length is the primary color, scarlet. It must first be assumed that the re-emission value of 37.5% is produced by the dyestuff scarlet alone, and on this assumption, the concentration of scarlet, K, of 0.035, representing the re-emission value, R, of 37.5% is found in curve C of FIG. 6.

Since, however, according to FIG. 6 the primary-color dyestuff blue, actually has a considerable influence on the real re-emission of the duplicating dye in the 510 mμ range, the value $K=0.035\%$ for the scarlet dye concentration must be corrected accordingly. The previously determined dyestuff concentration. 0.058% for blue (curve A), gives, as shown by FIG. 6, a corresponding dyestuff concentration for scarlet of 0.029%. For scar-

let, therefore, only the difference in the concentrations at wave-length 510 mμ is required, i.e. 0.006%, in order to obtain the desired emission value of 37.5%. The determination of the requisite dyestuff concentration at wave-length 404 mμ can be accomplished in an analogous manner. According to curve 1, FIG. 1, the original dyestuff requires a re-emission value of 45% at this wave-length. This, according to FIG. 7 (curve B), represents a concentration of the dyestuff of 0.0155% for the primary-color yellow. It can further be determined from FIG. 7, that the wave-length of 404 mμ, and the known blue dyestuff concentration of 0.058% represents a yellow dyestuff concentration (curve B) of 0.0095%. The influence of the known scarlet dyestuff concentration (curve C) of 0.006% at wave-length 484 mμ is very small, and is, as FIG. 7 indicates, at the most of the order of 0.001%. The corrected dyestuff concentration for yellow can be derived therefore from the difference between the total theoretical concentration of yellow, and the concentrations due to the influence of the blue and scarlet. This is, 0.0155–0.0095–0.001=0.005%.

Since the influence of the primary-color dyestuff yellow was ignored in the determination of the concentration of the scarlet dyestuff, a check must be made after the dyestuff concentration of the yellow has been determined, to ascertain if disregarding the influence of the yellow on the scarlet was permissible. In the above example, as shown by FIG. 6, this was the case. Should the influence of the yellow dyestuff concentration be significant, then the concentration which was first found for scarlet must be corrected in a known manner, according to FIG. 6, and this constitutes a check on the concentration of the yellow dyestuff.

A second correction of the concentration of the yellow dyestuff by correction of the concentration of the scarlet dyestuff, is, however superfluous in most cases in practice, a fact which can be immediately concluded from FIG. 7.

The recipe for the duplicate dyestuff for the above example accordingly is as follows:

	Percent
Dyestuff concentration for blue	0.058
Dyestuff concentration for scarlet	0.006
Dyestuff concentration for yellow	0.005

The spectral re-emission curve of the duplicate dye of this recipe is shown by curve 2 of FIG. 1. The correspondence is good, and lies within the range of practical tolerance. The slight deviations derive from a certain mutual influence which the used dyestuffs have upon each other. The deviations can, if necessary, be eliminated by means of a single correction, utilizing the above described methods based on FIGS. 5 to 7.

A test dyeing is carried out with the primary-color dyes, and the curves of the primary dyes will only be correct if each of the dyes have been completely taken up by the dye carrier material. In dyeing the dye carrier with the dye mixture, on the other hand, this is not necessarily the case, and much depends upon the nature of the material of which the dye carrier is made. Thus, for instance, wool absorbs considerably more dyestuff than do synthetic fibers. With the latter material, a somewhat lighter coloration is obtained, as is evident in curve 2 of FIG. 1. Thus, for example, a sample requires a re-emission of 37.5% (curve 1) at wave-length 510 mμ, while the duplicate dyeing, as shown in curve 2, gives a re-emission of 40% at this wave-length. From FIG. 6, it is evident that a re-emission of 40% (instead of 37.5%) would give a scarlet concentration of only 0.03, instead of 0.035. The difference, therefore is no longer 0.006%, but 0.011% for the corrected scarlet concentration. In this manner, a corrected recipe is obtained which now duplicates the dyeing characteristics of the original dye with considerably more accuracy. A single test dyeing with subsequent correction is sufficient in all cases occurring in practice, thus eliminating the numerous test dyeings and corrections by skilled personnel which were necessary until now, saving labor, material and permitting the employment of personnel of a lesser degree of skill, since the duplication of a color no longer depends upon the skill of the persons who proceed to the correction of the test dyeings.

I claim:

1. A method for duplicating a master dyeing obtained from an original dye mixture on a given dye carrier material, which comprises

(1) dyeing samples of said dye carrier material, each with one of a determined number of different primary-color dyestuffs in one of a determined number of different dyestuff concentrations, whereby individual samples of each primary-color dyestuff in each dyestuff concentration is obtained;

(2) measuring and plotting against wavelength the spectral re-emission values of each of these samples;

(3) measuring and plotting against wavelengths the spectral emission values of said master dyeing;

(4) plotting against dyestuff concentration those re-emission values taken from the curves obtained by (2) which correspond to the wavelengths for which the re-emission ratio of each primary color proportionate to the remaining primary colors has a minimum value;

(5) preparing a dyebath of a mixture of all of said primary-color dyestuffs containing each dyestuff in that concentration which corresponds in the curves obtained under (4) to the re-emission value taken from the curve obtained under (3) for the wavelength corresponding to the said re-emission minimum ratio of the respective primary color, and

(6) dyeing goods of the said dye carrier material, thereby obtaining dyeings substantially duplicating said master dyeing.

2. The method claimed in claim 1, wherein there is first prepared a bath of the primary-color dyestuff of that concentration which corresponds in the curve obtained under (4) to a re-emission value which is closest, for the wavelength of that color, to the re-emission value for the same wavelength in the curve obtained under (3), and adjusting the concentration of each of the other primary-color dyes with respect to the proportion of the re-emission values of the other primary-color dyes at their respective wavelengths, thereby attaining concentrations corresponding substantially entirely to the re-emission values of the curve under (3).

3. A method as claimed in claim 1, in which after determination of the primary-color dyestuff concentrations, a test dyeing is carried out, the test re-emission curve is determined and plotted, and then the concentrations of the primary-color dyebaths are adjusted in accordance with the differences in the re-emission values between said test re-emission curve and the re-emission curve of the original dyestuff mixture, at the wavelengths at which they were determined.

References Cited in the file of this patent

FOREIGN PATENTS

506,258	Great Britain	May 24, 1939
620,768	Great Britain	Mar. 30, 1949