May 30, 1944. W. G. FITZ 2,349,819

MULTICOLOR PRINTING

Filed June 12, 1941

Fig. 1.

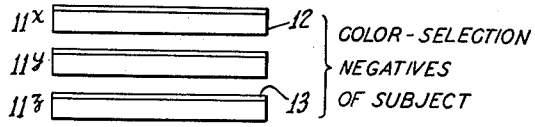


Fig. 2.

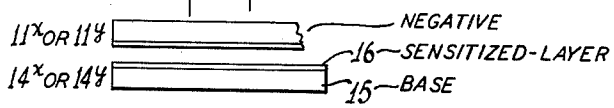


Fig. 3.

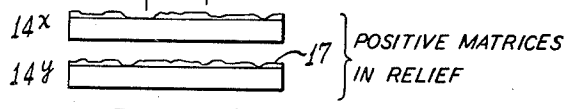


Fig. 4.

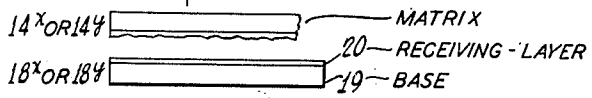


Fig. 5.

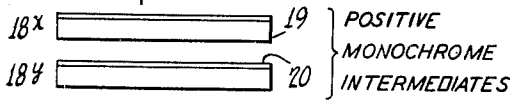


Fig. 5a.

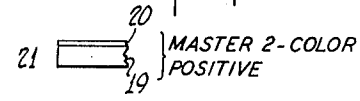


Fig. 5b.

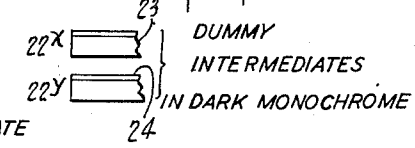


Fig. 6.

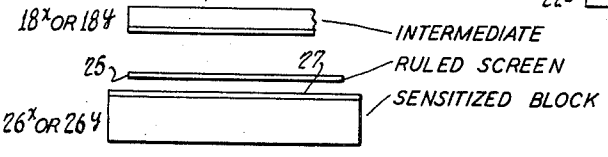


Fig. 7.

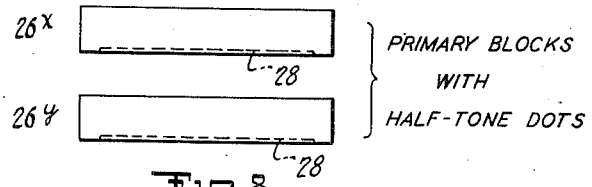
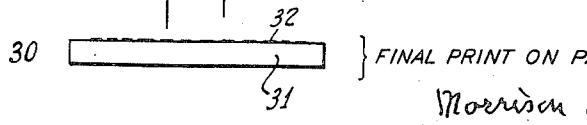


Fig. 8.



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UNITED STATES PATENT OFFICE

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MULTICOLOR PRINTING

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Application June 12, 1941, Serial No. 397,692

7 Claims. (Cl. 95—5.1)

This invention relates to multicolor printing, and consists of a novel art, process or system for the reproduction in printing colors, as for book or periodical pages, high-class trade catalogs, posters and other color prints, of various subjects or illustrations comprising pictorial representations, symbols, words or other matter, in two or more colors. A typical utility of the invention consists in the printing of reproductions or other subjects with the use of only two different inks or color stuffs as is common with the modern printing of illustrations and advertisements in periodicals and the like.

In the prevailing art prior to this invention there have been used with varying degrees of satisfaction several methods and systems of reproduction in two or more colors of various kinds of subject matter, landscapes, portraits, illustrations of manufactured goods and the like. In general such methods commence with what may be termed the studio work, involving photographic steps to produce color-representing negatives by exposure in a suitable camera, under the control of color filters, from which by later or engraver work a set of positive members or printing blocks have been produced, adapted for the successive printing of the partial images in suitable colors on the paper. Such prevailing systems however have suffered from various shortcomings, one of the most troublesome of which is unreliability, involving the difficulty or near-impossibility of affording the desired true or natural final color reproductions of the original subject, especially with two-color work.

The main object therefore of the present invention is to afford an efficient and convenient art, process or system of multicolor printing characterized by high accuracy and very close approximation to the full natural or desired coloring of the subject; especially whereby two-color work can be caused to approximate the excellence of work in three or more colors. A further object is to afford such a process or system wherein accurate or substantially absolute registration is assured of the combined or superimposed partial or successive printed images. It is another object hereof to afford, along with accuracy of results, expedition of handling and elimination of difficulties and undesirable delays. While the present invention is thus adapted to afford close similarity to the subject matter, even when only two colors are employed, at the same time it permits deliberate departures from perfect reproduction by an artificial or unnatural selection of colors, as for the purpose of producing striking effects with poster or other special work.

Other and further objects and advantages of the present invention will be pointed out in the hereinafter following description of one or more embodiments thereof, or will be understood to those conversant with the subject. For the attainment of such objects and advantages the present invention consists in the novel multicolor, or two-color, printing art or process hereinafter described, and the novel features thereof pertaining to method and steps and to agents and supplies used.

As a matter of definition, when a printing ink or color stuff is referred to this is intended to include stains such as analine dyes, which afford excellent reproduction colors; and to include as well the otherwise more desirable inks which are permanent colors, composed for example of pigments ground in vehicles or varnish, being water-free and more suitable for satisfactory printing. In referring to the printing member, by which ink is applied directly or indirectly to the paper, as a block, this is intended to include cylinders or other physical forms of printing member; and in referring to paper is to be understood any suitable surface adapted to receive the successive ink printings, usually of white character so as to exhibit the multicolor image by reflected diffusion of light.

A complete reproducing and printing system embodying the present invention comprises a certain series of stages or steps the initial and final of which may be largely conventional but with substantial novelty in the entirety due to decided changes in the character and order of the intermediate steps. The process commences with the photographic color-analysis and exposures of the subject, whether it be a two or three dimension object, and terminates with the printing in inks of different colors upon the final paper.

In analyzing and separating the color components of the subject the physiological primaries may be taken as green and orange and indigo, for purposes of description, and the secondary or printing colors, the complements of these, as red and blue and yellow respectively. These designations however are very approximate, as is well understood and, especially for two-color work, the secondaries may be rather an orange-red (as complementary to the green) and a green-blue (as complementary to the orange), when the third or yellow secondary is the one to be omitted.

As an example or illustration of the invention there will now be described a process or series of steps embodying the principles of the invention and affording the described advantages. This description will commence with what are herein termed the studio steps, including the stage of photographic analysis of the original subject, such as a colored picture or article of merchandise, to provide a set of color-separation negatives, and the next following stage to yield what will be termed intermediates, being certain positive prints adapted to be turned over to the engraver for the engraving steps.

In the first stage the color analysis of the original subject is preferably performed in a conventional way, by means of a camera in which specially sensitized plates are exposed behind color filters. These plates and filters may be selected for the production of three color-selection negatives representing respectively the green, the orange, and the indigo primary components of the subject. The camera may be of a type wherein the several exposures are made successively, permitting variation of diaphragm and period for each exposure; but it is preferred to use a camera, of which there are several makes available, which exposes the three plates in a single exposure. As early examples of such one-shot cameras or systems reference may be made to expired patents of Ives, numbers 1,153,229 of 1915 and 1,173,429 of 1916 and 1,238,775 of 1917. Such exposure followed by development of the plates yields three color-representing negatives, of conventional character, from which the succeeding steps of the present process are performed.

The next stage is the production of separate positive images. While all three negatives might be used to produce three positives, eventually combined as a multicolor print, it is preferable to employ only two of the negatives for producing two combinable positives, and any selection may be made for this purpose, such as using the green representing negative to produce a red printing positive and the orange representing negative to produce a blue printing positive. The third or indigo representing negative may be used in a collateral manner, for example as a byproduct to produce a black positive of the original subject, available for uncolored uses.

In the preferred embodiment of the present invention the stage of preparing the two separate positives in color is performed in two steps. Thus a set of two preliminary positives or matrices is first produced, for color image creation and transfer purposes, and therefrom a set of two intermediates, being two separate monochrome positives in different secondary colors; and these steps will next be described.

The preliminary positives or matrices may be produced in gelatin or other dye-absorbing material on a plate or film which is free from distortion under wetting and drying operations and is preferably transparent. The gelatin or equivalent layer of each matrix takes up its color selectively, thus to create a dye image, such as may be transferred to form one of the monochrome intermediates to be described. An advantageous method for this purpose is the imbibition method now well known, long ago described for example in the expired patents of Ives numbers 1,106,816 and 1,121,137 of 1914, wherein the sensitized gelatin layer is first printed under the negative and its unexposed parts thereupon washed off, affording a gelatin relief member or dye carrier by which the desired color image is produced merely through immersing the relief member in the dye solution, in this case a carefully selected red or blue stain, approximately complementary to the original primary colors.

Having obtained the two matrices or dye-carrying relief members the production of the intermediates may proceed; it being understood throughout that the various members, plates and films, negative and positive, shall be of identical dimensions and handled in such identical fashion as to preserve and ensure exact image registration at all stages.

Each of the matrices is now used to produce a separate monocolor intermediate, being a positive print in dye color upon a suitable surface; and as indicated the two intermediate positives may be of red and blue color respectively, the color stuffs to be carefully selected or mixed, by judgment of the studio artist, to give the most desirable and effective final printed results. The actual transfer or imbibition of image from each matrix to the corresponding intermediate may be under conditions of moisture and pressure for example as disclosed in said Ives patents. The preparation and use of this set of positive monochrome intermediates, as will be further explained, constitutes an important feature of novelty of the present process.

An important part of this stage of the process consists in the use of receiving members, sheets or supports for the set of intermediates which will be non-distortable, and yet may be substantially opaque or white, as paper, desirable for the proper viewing of the images. No known paper is adapted to serve the purpose, since wetting is necessary, which tends to create irregular expansion, while subsequent drying causes shrinking, with the result of such extensive distortions of dimensions and images as to render substantially inoperative any printing system proceeding therefrom. The special image support or receiving sheet for each of the intermediates may consist of a combination of layers, at least one of which is of fixed dimensions and free from distortion. Preferably a sheet or plate of impervious plastic material is used as the invariable base for this member; and an example of a satisfactory water resistant plastic is cellulose acetate, others including celluloid, lucite, and many other modern plastics, transparent or otherwise.

The receiving member for each of the intermediate positives therefore may consist of a sheet of such plastic material overlaid with a coating of gelatin or equivalent layer which can imbibe the dye image from the matrix. The receiving member may be transparent but preferably is translucent or opaque by reason of the base or coating containing a white ingredient, so as to afford view by reflecting action similar to that of paper. As one alternative the image support might consist of paper coated with gelatin and cemented upon the base or supporting plastic sheet, or plate of glass, or any other base material not subject to expansion and contraction from wetting and drying. By the use of such special supply material the several intermediates may be produced, maintained and used as of exactly the same dimensions and area, thus ensuring that after later steps the ink-printed images will have exact registration in the final product.

The described set of monochrome positive intermediates now becomes the starting point for

the engraver's work, the studio work being essentially completed. From these intermediates, respectively, he will perform the steps to produce the set of printing blocks.

However, in addition to the two intermediate monochrome positives, from which the engraver is to work directly as will be described, it is importantly desirable to have at hand a complete or two-color positive, to serve as a master positive print. The possession of this master color print affords a highly useful reference guide to the engraver, for purposes of inspection and study and for checking up with trial ink-printed images, which then can, if necessary, be adjusted as to the two ink colors used, until the true combination is secured satisfactorily like the master print and the original subject. Such a master print may readily be produced in manner similar to the monocolor intermediates, preferably using the same non-shrinkable support material and transferring to its coating in register both of the monochrome images, in any suitable manner, preferably by successive imbibitions from the matrices into the same gelatin coating layer.

Coming now to the engraving stage of the process, it has been explained that the engraver receives from the studio the two monochrome positive intermediates of the exact desired component colors and of corresponding dimensions, and preferably along with them the master or two-color print which is a combination of the two component images. His operations are to produce the necessary two printing surfaces or blocks. In commencing operations under the present process there is no need for the engraver to make any color analysis by filters or otherwise since, contrary to prevailing practice, he may now proceed to engrave the printing blocks by operating photographically directly from the two separate monochrome intermediates, for example of red and blue colors respectively. The analysis and separation work has been previously and accurately done in the studio, terminating with the two intermediates and with the two-color master print as a desirable supplemental means of comparison.

By the convenience and advantages of proceeding as thus described, and relieving the engraver of the task of color analysis, very substantial improvement is afforded in the total art or system of two-color or multicolor printing. Thus, for one thing, the engraver is able to select or mix his inks with great convenience and accuracy, having only to match the dye colors as they appear on the monochrome intermediates; this being readily performed with great certainty merely by direct comparison. Photographic separation is obviated, since the studio-prepared monochrome prints are calculated to produce exactly the two-color representation of the original subject which is shown in the master print. Thereby much cause of common inaccuracy is wholly avoided and the work of the engraver is practically so simplified that it becomes, for each printing block, the equivalent of working from black and white copy. No filtering is necessary for any purpose except possibly the conventional use of neutralizing or balancing filters, having to do only with matters of intensities or relative depths of color rather than any analysis or separation of colors.

In addition to these advantages it must be noted that by the present invention considerable prevailing difficulties are avoided in respect to the matter of filters for analysis, which otherwise would have to be made from the multicolor positive print if the engraver had only that to work from. This point is readily explainable due to the fact that there is no wide or unlimited choice of filters available for such work, these being relatively few in number; whereas the two component colors, freely selected in the studio for the purpose of the print in hand, may be of very extensive variety. Such a situation necessarily imposes on the engraver a practically insuperable task, requiring for photographic analysis the use of filters of colors precisely complementary to the respective monochrome colors which are combined in the multicolor print. The present invention overcomes these drawbacks.

The engraver may now proceed with the stage of preparing the two or more printing blocks, with each of them starting from one of the monochrome intermediates in which the image layer is upon a base or sheet of unvarying dimensions; so that at the printing stage the blocks are adapted to receive inks of the proper colors and impress them in exact register upon the final receiving paper. Various known engraving methods may be used and, in regard to the production of each printing block from an intermediate, the steps may be quite simple equivalents of those employed in black and white work, minimizing the skill required at this stage.

Thus stereotypy or relief methods may be used, in which the printing is from a raised surface. Halftone systems are available, of the kind involving relief in the sense of a printing surface composed of a raised pattern of dots or lines, brought about by conventional steps including an initial photographic copying of the intermediate by means of a ruled screen adjacent to the sensitized surface of the metal plate or printing block. Various photogravure systems may be used with this invention involving intaglio blocks carrying a sunk design, used with or without offset transfer from block to paper. The invention may also be carried out by lithographic printing steps of conventional character, or by the collotype system.

Taking as representative the halftone system, it may proceed generally as follows. For each intermediate positive is provided a blank or block, as of zinc or preferably copper. This is coated with gelatin, fish-glue or other medium capable of being sensitized as by a bichromate agent. It is exposed under the conventional line-screen through which the monochrome image is projected. The screen may be cross-ruled from 100 to 400 to the inch. The development may be by washing off the unaffected gelatin, thus leaving the image as a pattern of dots of varying sizes but level surfaces. The coating may next be heat hardened into an enamel, and the bare copper between dots then etched away by acid to enhance the relief. After any necessary retouching or hand etching the coating may be removed and the block is ready for printing. Areas of small dots or blanks represent the high lights, solid areas or large dots the shadows and other areas the half tones, as is conventional.

The printing from the set of blocks is conventional. Ink is applied by rollers or the like. Preferably the red image is first printed from the block made from the red intermediate, followed by the blue. The various possible depths and proportions of the two colors afford an infinite variety of possible hues, tints and shades, varying from substantial white where all dots are

mere points, to substantial black where the dots are maximum on both blocks.

In a broad aspect the invention can be performed without the need of preparing from the original negatives two preliminary matrix members to create and transfer dye images to the intermediates, although that step is preferable. From the negative set in some cases may be prepared directly a set or pair of separate monochrome intermediates, from which the set of blocks can be prepared as described. For example, from the orange representing negative may be printed a blue iron print as one intermediate, the other being printed in different ways, for example, as a relief to be dyed, or as a silver print to be converted by copper toning or otherwise to a red; and a two-color master print may be also provided by imposing one upon another of a set of such blue and red positive images; so that the engraver may start with these three positives as before.

By a modification of process, the monochrome color intermediates, as blue and red, may be spared from photographic use in preparing the printing blocks, though used for reference and to match inks with dyes, as before stated. Thus, besides the master or two-color positive and the two intermediates, blue and red, there may be prepared an additional or dummy pair of intermediates, the same as the blue and red ones, respectively, but both of some arbitrary dark shade approaching black, as brown, and preferably both of the same shade, better adapted to the photographic work necessary to prepare halftone or photogravure printing blocks, than are the blue and red members themselves, and so improving and quickening the photographic step. Obviously such dummies are the equivalent of the real intermediates for this work since in each case the blocks are to be prepared without attention to color, and as though from black and white copy, as explained above. Such dummies must be on the fixed-dimension supply sheets as before, and may be produced by imbibition or otherwise from the original negative set or from the preliminary matrices.

The invention so disclosed may be reviewed in connection with the accompanying drawing wherein Figs. 1 to 8 are diagrammatic edge views showing the preferred several members involved and indicating the preferred steps of the process, for two-color work.

In Fig. 1 are shown a set of three color-selection negatives 11^x, 11^y and 11^z representing the primary colors, as green, orange and indigo, of the subject. Each negative may comprise the conventional clear or glass base 12 upon which is the usual layer 13 containing the negative image. Fig. 2 shows the step of preparing photographically from each of negatives 11^x and 11^y a positive matrix of fixed dimension, the matrix material comprising a base 15 and a sensitized layer 16, for example, such as is used for creating colloid relief positives adapted to absorb and transfer dye colors. The third negative need not be used. Fig. 3 shows the set of separate positive matrices 14^x and 14^y indicated at 17 as in relief.

The next step is indicated in Fig. 4, the preparing from the matrices of a set of positive monochrome progressives or intermediates 18^x and 18^y, as of the respective secondary colors red and blue. The figure indicates that each intermediate comprises a base 19 composed of receiving material of invariable dimensions, such as an impervious plastic sheet, giving support to a receiving layer 20 to absorb the dye image. Fig. 5 shows separately the set or pair of positive monochrome intermediates 18^x and 18^y. Auxiliary to these Fig. 5^a shows a similar or master positive 21, but in this case printed in both colors, as from the two matrices 14^x and 14^y.

Fig. 5^b shows the alternative of providing supplemental to the intermediates 18^x and 18^y a set of dummy intermediates 22^x and 22^y each comprising a fixed dimension base 23 with its coating 24, in this case carrying a dark monochrome image such as is best adapted for photographic engraving purposes.

In Fig. 6 is shown the step of photographic preparation of each of the printing blocks, with the aid of the respective intermediates 18^x and 18^y, or their dummies 22^x or 22^y. The ruled screen 25 is interposed between the intermediate monochrome and the block or plate 26^x or 26^y of copper or other metal, having a sensitized surface or coat 27. The figure is only diagrammatic, and conventional camera-exposing means are to be understood, for example with lens between screen and illuminated monochrome. After these exposures, followed by development, washing out and etching, a pair of printing blocks 26^x and 26^y results, as shown in Fig. 7, each containing for example an area 28 of halftone dots. When these two blocks are used for printing with inks of colors which are secondary or selected to correspond with the colors of the intermediates 18^x and 18^y, the process results in the production of a multicolor print 30 as shown in Fig. 8, comprising a sheet of paper 31 carrying the two-color image 32.

There has thus been described a process for multicolor printing embodying the principles and attaining the objects of the present invention. Since many matters of method, steps, agents and supplies may be modified without departing from the principles of the invention, it is not intended to limit the same to such matters except so far as set forth in the appended claims.

What is claimed is:

1. The art or process of multicolor reproduction of various subjects which comprises, between the initial production from the subject of a set of selected color-representing negatives and the final use of a set of ink printing blocks to combine monochrome into a multicolor image or print, the following process steps: (*a*) preparing photographically from the negative set a set of separate fixed-dimension positive colored monochrome intermediates of different printing colors substantially complementary to the selected colors, (*b*) and preparing photographically from such respective monochrome intermediates without color separation a set of printing blocks for printing with such complementary colors chosen to match the colors of the intermediates respectively; the said monochrome intermediates comprising the respective color images carried on non-distortable white supports for viewing by reflected light, with which the engraver may directly compare the respective ink printed images for trueness of colors.

2. A process as in claim 1 and wherein a master multicolor positive is photographically prepared auxiliary to the set of intermediates and consisting of combined color images corresponding to those of the intermediates and affording a guide with which the engraver may directly compare the final printed image.

3. A two-color printing process comprising the steps of preparing photographically from a set of

two-color-selection negatives which represent selected component colors of the subject a set of two intermediates comprising reflective supports of fixed dimension, and carried by the respective supports positive monochrome images of colors substantially complementary to the colors represented by the negatives; and preparing photographically from the same negatives a reflective master two-color positive print, as a combination of two color images equal to those of the two intermediates; photographically engraving with the aid of such respective intermediates a set of printing blocks adapted for printing with inks of colors selected to correspond respectively with those of such intermediates for the production of final two-color prints; using the two reflective intermediates for comparison with the separate monochrome ink prints, and using the reflective master two-color print for comparison with the final ink print to test the color accuracy of the latter.

4. The art or process of plural or two-color printing of reproductions of various subjects, which comprises, between the initial studio production of a set of color-selection negatives representing selected component colors of the subject and the final use of a set of printing blocks to combine monochrome images into a two-color ink image, the following process steps: (*a*) preparing photographically from two of the negatives a pair of positive matrices upon bases of substantially non-distortable dimensions, (*b*) preparing, in the studio work, from such matrices a pair of separate positive monochrome intermediates both having substantially opaque white supports of non-distortable dimensions with carried images of different printing colors substantially complemental respectively to the colors represented by the negatives, whereby such intermediates are viewable by reflected light and thus useful in preparing and matching the respective printing inks for the engraving work; (*c*) and, in the engraving work, separately preparing photographically from such respective monochrome color intermediates, by conventional engraving methods, but without the need of color separation or filtering, a pair of printing blocks adapted respectively for printing with inks to be prepared or selected to correspond by direct matching comparison with the colors of such intermediates respectively.

5. A two-color printing process as in claim 4 and wherein the matrices are transparent colloid positives each adapted selectively to absorb wet dye color and thereby create a color image; and each intermediate comprises a colloid receiving layer upon a water-impervious white support; and each color image is transferred by imbibition under pressure from the matrix to the receiving layer of the intermediate.

6. A two-color printing process as in claim 4 and wherein at least one of the matrices is a wash-off colloid relief adapted to absorb selectively the dye color for transfer to the corresponding intermediate.

7. The art or process of two-color printing of reproductions of various subjects, which comprises, between the initial studio production of a set of color-selection negatives representing component colors of the subject and the final use of a pair of printing blocks to combine monochrome images into a two-color ink image, the following process steps: preparing photographically from two of the negatives a pair of positive matrices upon bases of substantially non-distortable dimensions, preparing from such matrices a pair of separate positive monochrome intermediates both having substantially opaque white supports of non-distortable dimensions with carried images of different printing colors substantially complemental respectively to the colors represented by the negatives, whereby such intermediates are viewable by reflected light and thus useful in preparing and matching the respective printing inks for the engraving work; preparing also, in the studio work, from such matrix pair a master two-color intermediate consisting of a substantially opaque white support carrying two registered color-images corresponding to those of the two monochrome intermediates, thereby affording for engraving purposes a complete two-color reproduction with which the final ink image may be compared; and, in the engraving work, separately preparing photographically from such respective monochrome color intermediates, by conventional engraving methods, but without the need of color separation or filtering, a pair of printing blocks adapted respectively for printing with inks to be prepared or selected to correspond by direct matching comparison with the colors of such intermediates respectively, the final two-color image being compared with said master intermediate.

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