

Dec. 26, 1933.

J. P. YOUNG

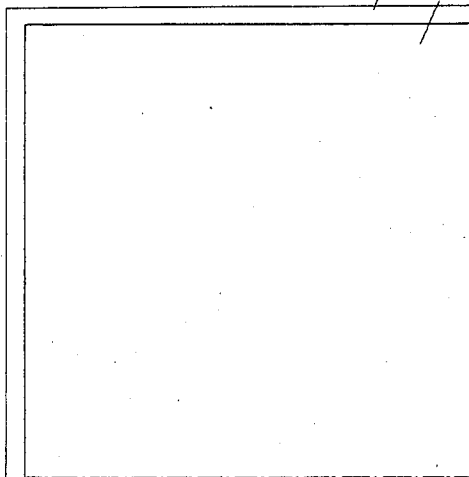
1,940,931

PROCESS OF REPRODUCTION BY PRINTING

Filed Sept. 10, 1929

2 Sheets-Sheet 1

Fig. 1. *P* *2*



*p*¹ *Fig. 2.*

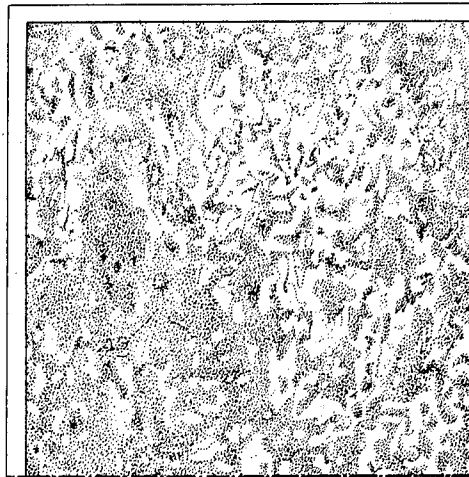
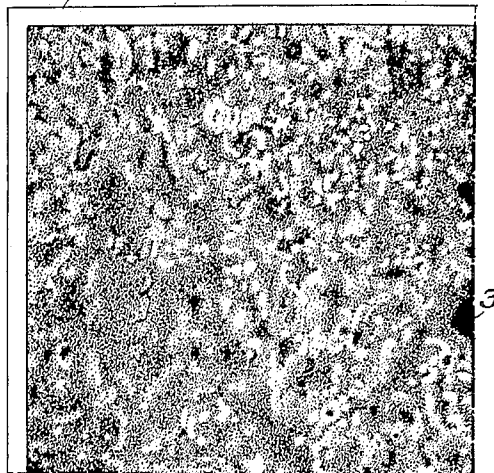


Fig. 3. *P*²



*p*³ *Fig. 4.*



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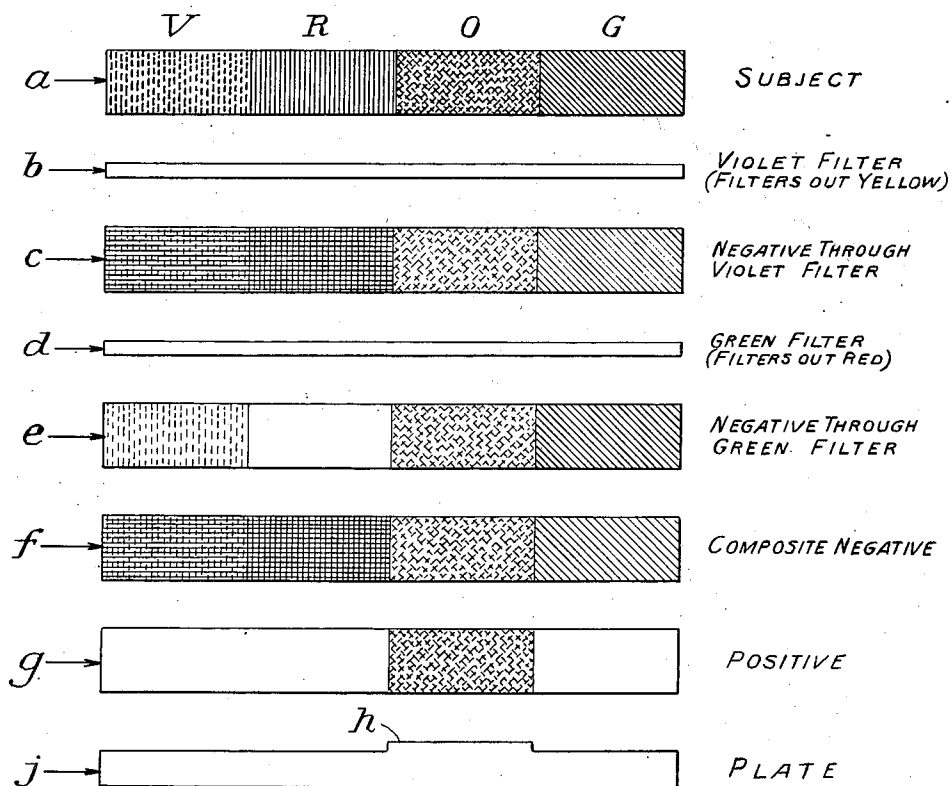
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Fig. 5.



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UNITED STATES PATENT OFFICE

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PROCESS OF REPRODUCTION BY PRINTING

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6 Claims. (Cl. 101—211)

This invention relates to a process of reproducing designs by printing and is particularly valuable for the reproduction of designs having various colors or various shades of the same color but without sharp lines of demarcation between such shades or colors. An example of such design is a marble pattern such as is produced in linoleum floor covering.

In an attempt to reproduce accurately such designs by printing for use, for example, in catalogues or advertising matter, the ordinary four-color process has heretofore been employed. In the ordinary four-color process it is desired to reproduce the red, blue, yellow and black portions of the design in varying proportions to suit the subject. The design is photographed without a filter to record the black portions thereof. The red portions of the design are obtained by photographing the design through a green filter. The blue colored portions of the design are likewise obtained by photographing it through an orange colored filter. In the same manner, the yellow portions are obtained by photographing the design through a violet filter.

Complementary filters are used in order that the color to be reproduced is blanked out on the negative. The negative being clear in the portions having the color which is to be reproduced, the positive will be black at those portions and the half tone made therefrom will have corresponding dots. When the half tone is employed to print the color which was photographed, the result is a reproduction of that color in the proper portions of the design. Each of the complementary filters produce on the photograph the content of a primary color. The black content is obtained without the use of a filter.

In the four-color process, moire effects are sometimes obtained by changes in the angle of the screens through which the photographs are taken. Other limitations are involved because the process is based on an optical illusion. The nature of four-color printing demands perfect registration of all four prints and any misregistration whatever causes incorrect color and moire. It is found in practice that the process has other serious limitations in printing designs of the character above referred to. If the color of one of the inks differs only slightly from the color for which the plate used for printing such color was made, the final printed design may differ widely in appearance from the original. This limitation frequently necessitates a long and expensive preliminary proving. It also involves sev-

eral expensive wash-ups on the press and costly periods of enforced idleness for the latter.

Where it is attempted to print several subjects at the same time as, for example, the printing of several designs on a single signature of a catalogue, some of the designs may not print properly because one of the plates has a portion or portions out of register. This misregistration occasions further delay and may require the making of new plates, or expensive correction of the original plates, as well as the loss entailed by the presses standing idle.

It is also characteristic of the four-color process that if one portion of the design is highly colored, the portions of the design adjacent thereto will not appear in their true colors. In other words, the four-color process is not accurate in reproducing contrasting portions of a design. The use of the four screens employed in the process to cover each subject entirely, diminishes the soft blending of colors characteristic of marble and reduces the opacity of these colors which should appear solid. It is difficult, if not impossible, to reproduce accurately a marble design by the four-color process so as to give the desired visual effect. Instead of the different colors or shades of color blending and presenting the soft appearance characteristic of marble designs, the four-color process gives a patchy and generally inferior reproduction thereof.

To overcome the objections recited hereinabove, I form half-tone plates having printing areas which correspond to areas of different colors in the design, and use these plates in the printing step with inks whose colors correspond to the actual colors of the design. In order to make the plates I first photograph the design through filters which are complements of colors whose composite is the color of the desired area. Therefore, if there are, say, orange areas in the design, then the orange areas are printed from a half-tone having printing areas of the proper configuration and using orange ink; whereas in ordinary four-color work the printer would be expected to obtain the orange by printing yellow dots and red dots over the same area. If there is purple in the design, it will be printed from an appropriate plate using purple ink, whereas in the four-color process it would be formed by printing blue dots and red dots over the same area. From the above examples it will be seen that in the four-color process the red half-tone would be expected to print red as an element of purple areas and of brown areas. Similarly, the yellow plate might be required to print one color

element for orange areas and also for green areas. Therefore, in the four-color process the areas to be printed by any given color are not, except in the extremely rare case where primary colors alone are present in the design, the same as the discrete color areas of the design. In the present process there is no hard and fast relationship between the colors of the ink applied by any printing plate, and the color of the design for which the plate was made. This is probably due to optical illusion and blending of colors such that the ink employed may not be of precisely the color which appears to the eye in the design.

Preferably the half tones are printed over a solid base color corresponding to the lightest color in the design. Where one of the colors which is to be applied by the half tones appears in the design as a solid patch, the composite negative for that color is painted by hand or "staged" so as to produce a solid patch on the half tone, thus causing the printing of a corresponding solid patch of color on the paper.

By my process highly improved effects are obtained. The true marble appearance, for example, is readily attained and the printed designs are clean cut and satisfactory in every respect. Instead of printing several designs with three runs of the press, the several impressions required for each design are separately made. While this may seem to be expensive, it proves in fact to be entirely satisfactory from the point of view of cost because of the elimination of press delays, plate corrections and reproving and re-registering.

The number of runs through the press may be reduced with the split inking fountains now widely used on printing machines.

The accompanying drawings illustrate the several steps in producing a marble design by my improved process.

In the drawings:
 Figure 1 is a view illustrating the base color;
 Figures 2 and 3 are views illustrating half tone designs which are to be successively printed over the base color;
 Figure 4 is a view of a final printed design; and
 Figure 5 is a diagrammatic view illustrating by way of example successive steps in the carrying out of my process.

As stated, Figure 5 is diagrammatic. It has been attempted in Figures 1 to 4 to show the variation of light and shade. These drawings have been made from enlargements of actual half-tones employed.

In carrying out my improved process, the design to be reproduced is first carefully analyzed so as to determine what colors are contained therein. A plate is made for printing a substantially solid base color which corresponds to the lightest color or the underlying tone of the design. Figure 1 shows a piece of paper P having the base color 2 printed solidly thereon.

If it is desired, for example, to reproduce a design including an orange colored portion, say an orange streak in a marble pattern, this is accomplished by photographing the design through suitable filters to blank out the orange colored portion. The resulting negatives are then superposed and a composite positive is made from the combined negatives. A filter of violet color may be used, for example, to blank out the yellow value in the orange portion of the design, and a filter of green color may be used to blank out the red values. In order to remove any confusion in terms, I herein denominate the filters employed by the color of the light which they will pass; that is to say, a filter which passes violet light is denominated a "violet" filter. By using the proper filters there are obtained negatives which in the example given are clear in those portions of the design having, respectively, the red and yellow values of the orange. These negatives are superposed as a single negative and a composite positive is made.

It is of course desired to obtain a half-tone area as opposed to a solid area for printing. This requires the introduction of a screen, and while the screen may be introduced at any desired time, I prefer to introduce it in the making of the first negatives for the reason that gradations in tone, which are desirable at the edge portions, will be most effectively registered when the screen is introduced at this stage. This requires the use of the screen with a negative taken through each of the several filters, and therefore requires care in registration of the plates; but, as stated, it is advantageous in that gradations of tone at the edge portions of different color areas are more accurately obtained.

Another way to introduce the screen is to make negatives through the several filters but without the use of any screen at this stage; then to superpose the negatives and make a positive plate from the composite negative. The composite plate is then used to make a print. The print is then illuminated and used as a subject for photographing the printing plate, the screen being introduced between the print and the plate. As stated, however, I prefer the method first described.

By following the procedure above outlined there is formed a single half-tone plate having the color values of the original design, although the colors were broken down during reproduction. This permits the use of standard filters which are complementary to the primary colors and which therefore can produce at least theoretically any combination desired.

When composite photographs of the color values of each color in the design have been made, corresponding half tones are produced and are employed in the usual manner to print portions of the design in various colors. In my process, the ink applied to the paper by the half tones may be of a color slightly different from the color for which the composite photographs were made, but this difference, as pointed out above, does not produce any undesirable effect on the final result.

In the drawings I have illustrated a marble design employing only two colors in addition to the base color. One of the half tone prints is shown in Figure 2 as impressed on a sheet of paper P¹ and the other is shown in Figure 3 as impressed on a sheet of paper P². Figure 4 illustrates the final design which is formed by printing the half tone designs of Figures 2 and 3 successively over the solid base color of Figure 1. I have illustrated at 3 in Figure 4 a patch of solid color. This patch is obtained by staging the negative from which the half tone of Figure 3 is made so as to form a patch 3' of solid color on the half tone of Figure 3. In other words, instead of relying on the dots in the half tone to approximate the effect, I go over the design carefully and stage in the solid patches. The staging is done by retouching the printing plate with staging ink, or, if desired, the staging could be done on the negative from which the plate is made. It is more easily done, however, on the solid plate. This can be readily done in my process because

of the fact that the colors applied by the half tones are the actual colors of the design, or substantially so, and there is no necessity for having discrete dots of different primary colors combining to give the desired final color effect to the eye.

Figure 5 illustrates diagrammatically the several steps in the process. The subject shown at *a* is illustrated as having four component parts which are, respectively, violet, red, orange and green, these parts being indicated by the letters V, R, O and G. The subject is photographed through a violet filter *b* which filters out the yellow constituents of the orange and green of the subject. It passes the violet and red colors completely; in other words, light passes from the violet and red portion of the subject through the filter and strikes the plate whereby the negative in those portions corresponding to the violet and red is opaque. The negative resulting from the photographing of the subject through a violet filter is shown at *c*. I have indicated by light cross hatching that the plate is struck to some extent under the orange and green portions by reason of light coming through corresponding to the red portion of the orange and the blue portion of the green; it being borne in mind that the yellow values are filtered out completely by the violet filter and that the plate is therefore transparent in those portions corresponding to the yellow values of the orange and green. The exposure of the other negative described below is indicated in like fashion.

The subject is also photographed through a green filter *d* to form the negative *e*. These negatives are assembled in registration with one another to produce the composite negative *f*. It will be noted that the portions corresponding to the violet, red and green are opaque, whereas the portion corresponding to the orange is partially transparent due to the fact that the violet filter passed some red in the orange and the green filter passed some yellow. A positive *g* is formed from the negative *f*. The positive, of course, is made on the metal which forms the plate, and after development and etching, there is left upstanding that portion of the design which was printed through the composite negative as indicated at *h* on the plate *j*. Of course, a positive may be otherwise printed either for purposes of checking the composite negative or for the purpose of rephotographing through a screen as above described.

My process provides a method for analyzing the colors of a design into their primary color values. The primary color values are then re-combined into a composite photograph from which the half tone is produced. The composite or combined negatives of the primary color values comprising a given color to be reproduced make it possible to get the color value appearing in the original design on the printing plate and thus on the final product. By filtering the colors in a design by means of positives until a print has been made of each color as it appears to the eye in the subject, half tones may be produced for printing these colors over a solid base color. Each plate in the printing carries a color which corresponds to a color in the design as it appears to the eye.

Numerous advantages of this process have been pointed out hereinbefore, and I am able to overcome substantially all of the objections to the present process which have been discussed previously.

I have illustrated and described the present

preferred embodiment of the invention as applied to the printing of a marble design. It will be understood, however, that this is by way of illustration only and that the invention may be otherwise embodied or practiced, within the scope of the following claims.

I claim:

1. In the process of reproducing a design by printing, the steps consisting in printing a base color corresponding to the underlying tone of the design, photographing the design through filters of color complementary to the primary colors in the design, superposing the photographs thus made, making a half tone from said superposed photographs and printing with the half tone over the base color.

2. In the process of reproducing a design by printing, the steps consisting in printing a substantially solid base color, photographing the design through filters of colors complementary to the primary colors in the design, superposing the photographs, making a half tone therefrom and printing with the half tone over the base color.

3. In the process of reproducing a design by printing, the steps consisting in printing a base color corresponding to the lightest color of the design, photographing the color values of the design through filters of colors complementary to the actual colors in the design, making a corresponding half tone from the composite of the photographs of color values, and printing with the half tone over the base color.

4. In the process of reproducing, by printing, a design having areas of color which are other than primary colors, the steps consisting in photographing each such area through filters which are complements of colors whose composite is the color of such area, making composite photographs from those photographs taken through such filters, thereby to produce photographic areas corresponding to the aforesaid areas of the design, making half-tones from said composite photographs, and printing with the half-tones in inks corresponding in color to the color of the corresponding areas in the design.

5. In the process of reproducing, by printing, a design having areas of color which are other than primary colors, the steps consisting in photographing each such area through filters which are complements of colors whose composite is the color of such area, making composite photographs from those photographs taken through such filters, thereby to produce photographic areas corresponding to the aforesaid areas of the design, making half-tones from said composite photographs, staging at least one of the half-tones, and printing with the half-tones in inks corresponding in color to the color of the corresponding areas in the design.

6. In the process of reproducing, by printing, a design having areas of color which are other than primary colors, the steps consisting in printing a base color corresponding to the lightest color in the design, photographing darker color areas of the design through filters which are complements of colors whose composite is the color of an area, making composite photographs from those photographs taken through such filters, thereby to produce photographic areas corresponding to the aforesaid areas of the design, making half-tones from said composite photographs, and printing over the base color with the half-tones in inks corresponding in color to the color of the corresponding areas in the design.

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