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PRESS PROCESS OF MAKING REPRODUCTION IMPRESSES AND PRODUCT THEREOF

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This invention relates to the class of printing, and it is among the objects of the invention to make reproduction impresses which are luminescent in exposure to fluorescigenous radiant energy, of subject matters, the compositions of which include highlights, tones and shadings. A further object of the invention is to apply inks containing fluorescent agents from mechanical plates to light-reflecting receiving surfaces in multitudinous minute areas so arranged in critical dot and line structure that the completed print, when viewed in filtered ultra-violet light, accurately portrays the true form, color, expression and general characteristics which are apparent when the original subject matter is viewed in normal visible light.

Another object and purpose of the present invention is to make luminescent impresses, in which the effect of highlights and other light sections in filtered ultra-violet light is produced by printing a relatively large number of minute areas of light-producing fluorescent inks, allowing a relatively small portion of the white or other light-reflecting receiving surface to remain untreated, while the effect of darker sections in filtered ultra-violet light is produced by printing a relatively small number of widely separated minute areas of fluorescent inks, allowing broad expanses of the white receiving surface to remain untreated; this is in contra-distinction to the well-known procedure in orthodox color printing, by which the effect of highlights is produced by printing a relatively small number of widely separated, minute areas of light-absorbing colored inks, allowing broad expanses of the unprinted light-reflecting receiving surface to predominate, while the effect of darker tones is produced by printing a relatively large number of minute areas of light-absorbing colored inks, allowing a relatively small portion of the unprinted light-reflecting receiving surface to show through.

A further object of the invention is to construct and arrange the ink-supplying portions of the printing plates in such a manner that the new reproduction media, namely, light-producing fluorescent inks, will be applied in proper positions and quantity upon the receiving surface of the paper, so as to give a true and recognizable portrayal of the original subject matter when the resultant print is observed under a new viewing condition, namely, filtered ultra-violet light.

The multi-color or three-color reproduction printing of orthodox, non-fluorescent, colored inks, as generally practiced, comprises the suc-

cessive application of two or more different colored inks, each capable of absorbing different wave-bands of incident white light. Such inks are printed in discontinuous minute areas upon a white receiving surface, so that the composite unabsorbed incident light reflected from a given small section of the printed surface is decreased in intensity and narrowed in visible spectrum by each successive application, to the extent that said given area portrays the desired brilliancy and color. It is an object of this invention to successively apply two or more fluorescent inks, each capable of fluorescing in different wave-bands; said inks are to be so printed in discontinuous minute areas upon a white receiving surface that the composite light-emission from a given small section of the printed surface, during exposure to filtered ultra-violet light, is increased in intensity and expanded in visible spectrum by each successive application to the extent that said given area effects the desired brightness and color of fluorescence.

An important purpose of this invention is to increase the range of fluorescent tones and colors by using selected light-absorbing materials in conjunction with light-producing, fluorescent inks; that is, to vary the fluorescent color of a print to any desired extent by printing a non-fluorescent substance which has been chosen specifically to absorb certain wave-lengths of the light-emission from the light-producing fluorescent inks. In practicing this invention, these selected light-absorbing substances are sometimes applied prior to the fluorescent printing; they are sometimes mixed directly with the fluorescent inks, and they are sometimes printed after the fluorescent inks have been applied.

It is among the further objects of this invention to reproduce a complete picture or other composition, which includes shadings, tones, etc., by printing fluorescent inks in multitudinous minute areas so arranged that the completed print, when viewed in filtered ultra-violet light, accurately portrays the true form, color, expression and general characteristics which are apparent when the original subject matter is viewed in normal visible light; this luminescent reproduction is to be made upon a receiving surface which also supports a satisfactory non-fluorescent reproduction of another subject matter printed in orthodox colored inks, and so arranged as to substantially avoid any interference with the luminescent effect produced by the fluorescent reproduction when exposed to fluorescigenous radiant energy.

This invention further provides for the making of duplicative luminescent reproductions which, under substantially invisible ultra-violet light, portray a decided effect of third-dimension because of the extreme contrast apparent when light-producing inks are printed on backgrounds which are virtually unseen under ultra-violet rays, thus giving depth, realism, and all dimensions to luminescent reproductions of three-dimensional subject matters.

Lacquers of luminescent character are well-known and their application by hand brushes in the painting of individual productions, pictorials or lettering, as desired, is likewise known. Many pigments used, as zinc or calcium sulfides, have been of coarse size necessarily, because if finely ground, they tend to lose their luminescent properties. Such coarse pigments cannot be used successfully for the purposes of this invention, as they pile or block the fine recesses of fractional-tone printing surfaces and the like, and, furthermore, the vehicles ordinarily used for carrying the known luminescent materials are not workable by such printing press surfaces because of their adverse characteristics, as improper drying rate, improper viscosity and tack, possible attack on plate or offset transfer surfaces, etc. However, with new fluorescent inks described herein as being compounded for the specific purpose of printing minute dots, fine lines, delicate checkerboard areas and other fractional-tone structures, it now becomes possible to make duplicative reproduction impresses in any desired number, without drying or distributing difficulties or attack on the plate or transfer surfaces, the product being beautifully luminescent in exposure to fluorescent radiant energy.

Heretofore, in the identification and crime detection fields, it has been known to apply a fluorescent mark to an article by block or line printing for the purpose of rapid identification of the article by the fluorescence of the mark in filtered ultra-violet light. The present invention, however, relates to the totally different art of duplication with fluorescent media of pictorial, advertising, and other subject matters of a graphic nature, and is to be clearly distinguished from such well-known and obviously remote identification and crime detection systems in that it provides for the arrangement of multitudinous minute areas of fluorescent inks on a receiving surface so that the completed impress duplicates and accurately portrays, in filtered ultra-violet light, the true form, color, expression and general characteristics which are apparent when the original subject matter is viewed in normal visible light, this to be accomplished by special procedures herein disclosed for applying new light-producing reproduction media rather than the light-absorbing media used in orthodox color printing.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative however, of but a few of the various ways in which the principle of the invention may be employed.

In the printing trade as generally practiced, subject matters which include shadings, tones, and highlights are reproduced by the application of light-absorbing colored inks in multitudinous minute areas so arranged that the completed

print portrays in normal visible light the true form, color, expression, and general characteristics which are apparent when the original subject matter is viewed under similar lighting conditions. The term "light-absorbing" as herein used is intended to describe substantially non-fluorescent substances, such as black inks, orthodox coloring matters, and papers, each capable of absorbing certain wave-lengths of incident visible light. Such colored inks, for example, are normally effective for reproduction purposes only when the incident rays of light striking them include some visible light between 4000 and 8000 Angstrom units in wave-length. Colored inks absorb a portion of the energy in this range, and reflect or transmit the balance, whereas the paper receiving surface upon which they are printed usually reflects a large proportion of the visible light striking it.

"Light-producing" fluorescent inks may be differentiated from such light-absorbing inks in that the fluorescent inks are effective to a maximum degree only when the incident rays striking them include some energy shorter than 4000 Angstrom units in wave-length, and they are most effective when a large proportion of the visible light has been filtered out of the incident rays to provide a substantially unseen incident ray. The term "light-producing" as herein used is intended to describe certain fluorescent substances capable of converting incident fluorescent radiant energy into visible light; that is, capable of transforming unseen wave-lengths shorter than 4000 Angstrom units into visible light longer than 4000 Angstrom units in wave-length. X-ray tubes, cathode tubes, and carbon arc equipment, for example, can be used to produce fluorescent radiant energy to excite impresses of our light-producing fluorescent inks, but we generally employ mercury vapor lamps fitted with jackets of nickel oxide glass or dark colored "Corex," in accordance with well-known practices in the vapor lamp industry, to substantially eliminate the visible light from the lamp and to pass only the invisible ultra-violet radiations desired.

The term "light reflecting" as herein used is intended to describe certain substantially non-fluorescent substances, as white or light-colored papers or pigments, capable of reflecting a relatively high percentage of incident light striking them. Each tiny particle of fluorescent ink applied to such a light-reflecting surface converts invisible ultra-violet light into visible light and exhibits maximum brightness when its light-emission is substantially reflected by the surface beneath. Thus, each particle of fluorescent ink printed upon a proper light-reflecting surface throws off a distinct beam of visible light during exposure to fluorescent radiant energy, and for the purposes of this invention becomes a separate and distinct source of visible light requiring accurate placement upon the paper in the exact position where a highlight is desired. When a luminescent impress upon such a light-reflecting receiving surface is viewed under filtered ultra-violet light, the unprinted portions of the surface reflect this incident light, but still appear to the observer to be very dark because such rays are substantially unseen by the human eye.

The term "highlight" as herein used is defined as and intended to include the lightest or brightest parts of a reproduction impress under the particular lighting condition in which it is de-

signed to be viewed. In duplicative luminescent printing, the greater the number of fluorescent particles printed in a given area on a light-reflecting receiving surface, the greater will be the resultant intensity of fluorescence from that area, and the greater will be the apparent brilliancy of the highlight in filtered ultra-violet light. Generally, increases in brilliancy of fluorescent highlights may be accomplished by increasing the size, number or thickness of the minute areas of fluorescent ink applied per unit area of the surface, while decreasing same results in the darkening of fluorescent shades; fluorescence brightness in any given section of the print is normally in a substantially direct proportion to the size, number per unit of area and/or thickness of the fluorescent fractional-tone structures in said section, or to the total volume of fluorescent ink printed therein.

For the purposes of this invention, we employ fluorescent materials which may be handled in the general manner of inks, and which are of transparent or opaque character, as desired, and of a viscosity and tack workable on press surfaces. The materials print as feasibly as orthodox non-fluorescent inks, without bleeding, piling, spreading, burring, mottling or becoming fuzzy, thus producing clear tones, shadings, and other delicate reproductions, and setting with sufficient quickness to prevent offset, and to permit very rapid handling. As ink-like material operative with press, offset or reticulated screen supplying surfaces, we usually provide fluorescent agents in printing vehicles on the order of drying oil bases, such as linseed varnishes, tung oils, etc. For example: A weak solution of sodium hydroxide is saturated with diamino-stilbene-di-sulphonic-acid, and to one ounce of such solution there is added six ounces of glucose, and after thorough stirring, the mixture is stirred into about nine ounces of aluminum hydrate ground in clear linseed varnish No. 1, in proportion of 4 parts of hydrate to 5 of the varnish. Then, three ounces of clear linseed varnish No. 00 is added, and the mixture is ground on the mill. Where desired, the aluminum hydrate component may be omitted, but generally it is preferable. Prints made from this ink, when exposed to fluorescent radiant energy, fluoresce whitish-blue. By substitution of berberine sulphate for the diamino-stilbene-di-sulphonic acid a product fluorescing yellow-green may be had, and by substitution of tetraethyl - diamino - o - carboxyphenyl-xanthenyl chloride, $C_{23}H_{31}N_2O_3Cl$, a product fluorescing red may be had, and by substitution of tetramethyldi-amino - diphenyl - ketonimine hydrochloride, $C_{17}H_{22}N_3Cl.H_2O$, a product fluorescing green may be had. A mixture of equal parts of the latter two yields a product fluorescing orange, while a mixture of one part of the red fluorescing ink with eleven parts of the green fluorescing ink yields another yellow fluorescing ink.

The printing industry of today generally reproduces originals provided in convenient forms, such as sketches, photographs, paintings, designs, letterings, etc., to illustrate the form, colors, expressions and general characteristics desired in the duplicates. Such sketches are substantially effective and useful only when viewed in normal visible light, because they are rendered in colored light-absorbing media. Luminescent reproduction procedures take many widely varied forms, some of which are described

in the following illustrative, but in no way limitative, examples:

Example 1.—In the practice of this invention, we may produce fluorescent duplicates of such non-fluorescent original sketches by printing fluorescent materials in the general manner of an ink on light-reflecting receiving surfaces, with mechanical supplying plates or screens so manufactured, photographically or manually, that the multitudinous ink-supplying areas are relatively numerous on those sections of the plate or screen designed to print fluorescent highlights, and relatively sparse on those sections designed to produce darker fluorescent tones. During the making of the printing surface, any desired increase in the brightness of a highlight on any particular section of the final print may be obtained by altering that portion of the printing surface so that the fractional-tone structures in fluorescent ink applied to the paper will be increased in number, size and/or thickness to effect the increase in brightness of the highlight desired. In a similar manner, any alteration in the printing surface causing any decrease in the number, size, and/or thickness of the fractional-tone structures in fluorescent ink applied to the paper, will result in a corresponding darkening of the shade in that particular section of the print. In certain cases the plates we manufacture to meet this requirement are negatives or photographic reversals of plates which would be used in reproducing the same subject matter with orthodox light-absorbing inks.

Example 2.—Another procedure of making luminescent reproductions consists, firstly, in manually duplicating the original non-fluorescent colored sketch, using commercial fluorescent water colors or oil colors, for example, so as to accurately portray in filtered ultra-violet light the true form, color, expression and general characteristics which are apparent when the non-fluorescent sketch is viewed in normal visible light; secondly, in flooding the resultant fluorescent sketch in a darkened room with intense ultra-violet light from which visible radiations have been substantially eliminated; thirdly, in interposing an ultra-violet filter, such as a yellow "K-2 Wratten" gelatine, before the camera lens to pass the visible light from the fluorescent areas of the sketch, and absorb the ultra-violet light reflected from the walls, untreated portions of the sketch, etc.; fourthly, in interposing any reticulated half-tone or other screen required for the making of the particular type of printing plate to be used, whether for intaglio, relief, planographic, or other printing; fifthly, in photographing the fluorescence of the sketch, and when more than one fluorescent color is to be printed, successively exposing a series of sensitized surfaces, using color separation screens to separate different ranges of the visible light produced by the different fluorescent paints used on the sketch; sixthly, in making the mechanical printing surfaces by exposing sensitized plates through the resultant photographic images; seventhly, in applying, by means of the prepared printing surfaces, inks which fluoresce in ranges identical to the ranges produced by the fluorescent materials on the fluorescent sketch, automatically placing the fluorescent inks in positions corresponding to the fluorescent sections of the sketch; and eighthly, during said application, in constantly checking the reproductions in darkness under filtered ultra-violet light to make certain that the plate is in proper register,

and is supplying a sufficient quantity of fluorescent agent at all times.

If red fluorescing and whitish-blue fluorescing inks be used in such a reproduction, brilliant fluorescent red highlights are produced by crowding together a sufficient number of minute areas of the red fluorescing ink on a given section of the paper, while brilliant fluorescing whitish-blue highlights are produced by crowding together a sufficient number of the proper sized areas of whitish-blue fluorescing ink to give the desired intensity in that section. If any given section of the reproduction calls for a brilliant fluorescing pink highlight, a sufficient number of minute areas of whitish-blue fluorescing ink are printed between areas of red fluorescing inks to produce the desired shade of fluorescent pink. The red fluorescing areas emit beams of red light during exposure to fluorescigenous radiant energy, while the whitish-blue fluorescing areas emit beams of whitish-blue light, with the result that the eye perceives that part of the composition as a brilliant pink highlight. Thus, it is seen that the composite of the light-emission from a given section of the receiving surface may be increased in intensity as well as in color range by successive applications of additional fluorescent inks to the extent that the desired brightness and color of fluorescence are effected in said section.

Where the red fluorescing and whitish-blue fluorescing inks are used, the fluorescent shades may be varied widely from blue to orchid, to pink, to red, by altering the comparative quantity of the two different fluorescent inks printed in a given area, as well as by altering the relative positions of the different fluorescing areas. If the fluorescing red areas predominate in size, number, or thickness, or the fluorescing red dots have been printed last and have been so placed as to partially over-lap the blue fluorescing dots, the shade will predominate on the red fluorescing side, and vice versa. Therefore, it is readily seen that the composite of the light-emission from any given group upon exposure to fluorescigenous radiant energy is widely altered in intensity and color range by alterations in the relative positions of the minute areas of different fluorescent inks. A very wide range of such fluorescent tonal gradations may be produced by such alterations, through the use of any plurality of inks fluorescing in substantially different colors. Generally speaking, the results obtained are substantially the same as those resulting when beams of different colored light are blended. If green fluorescing and whitish-blue fluorescing inks be printed, alterations in the relative positions of the two series of dots result in variations from fluorescing green to greenish-white, to cold white, to bluish-white, to blue, while corresponding alterations in the relative positions of minute areas of green fluorescing and orange fluorescing inks result in variations from beautiful fluorescent shades of green to yellow green, to yellow, to chrome, to orange. Correspondingly, the alterations above-described may result in a wide range of fluorescent chromes and fluorescent oranges when fluorescing yellow and fluorescing red inks are printed.

If three different fluorescing inks, such as fluorescing blue, fluorescing yellow and fluorescing red, are printed, it is possible to produce fluorescence in virtually the entire visible spectrum by altering the relative positions of the minute areas of the different fluorescing inks, by altering the extent to which the different series of dots are

superimposed one over another, and by altering the relative size, number or thickness of the minute areas of the different fluorescent inks. Through the use of the three above-mentioned fluorescent inks, it is possible to produce printed areas from which the composite light-emission during exposure to fluorescigenous radiant energy is perceived by the eye as almost a pure white, and it is interesting to note when this is accomplished that the different dots are placed in superimposed positions substantially similar to those which produce black when printed in the orthodox light-absorbing red, yellow and blue colored inks used in ordinary color reproductions.

Example 3.—It has often been found necessary to produce a luminescent print which has a complete composition in daylight, and which also portrays a complete and sometimes different fluorescent composition when viewed in filtered ultra-violet light. This is accomplished by the printing or ink materials providing the necessary fluorescent agents, in multitudinous minute areas so arranged that the completed print, during exposure to fluorescigenous radiant energy, accurately portrays the true form, color, expression and general characteristics which are apparent in the original subject matter when it is viewed in visible light; said surface also receiving a satisfactory non-fluorescent reproduction impress printed in orthodox colored inks, so arranged as to substantially avoid any interference with the luminescent effect produced by the fluorescent impress when exposed to fluorescigenous radiant energy. The techniques used in producing such a result include the placement of the minute areas of fluorescent inks on the paper between the dots of non-fluorescent light-absorbing colored inks, as well as the partial superimposition of the fluorescing dots over the non-fluorescent dots in cases where the non-fluorescing inks are very light-colored. The extent to which the fluorescent and non-fluorescent series of dots are overlapped is determined by the extent to which it is desired that the fluorescence be altered in color and intensity by the light-absorbing colored areas.

The specific steps involved in accomplishing the above may consist, firstly, in manually constructing a sketch which includes the desired fluorescent composition painted with commercial fluorescent artist oils, as well as a satisfactory non-fluorescent rendition of another subject matter painted in conventional light-absorbing non-fluorescent artist colors so arranged and constructed as to substantially avoid any interference with the luminescent effect produced by the fluorescent composition when exposed to fluorescigenous radiant energy; secondly, in photographing and reproducing the fluorescent rendition of the prepared sketch by the methods and steps outlined in Example 2; and thirdly, in photographing the resultant sketch in visible light, using orthodox color separation screens and half-tone screens, making plates from the resultant photographic images, and printing, by means of the prepared plates, non-fluorescent colored inks which match the non-fluorescent colors used on the sketch.

Example 4.—Although it is the general practice to print duplicative luminescent reproductions upon a white paper stock which is a good reflector of light, an extended embodiment of this invention entails the application of ink materials providing substantially opaque fluorescent agents, in which case the color of the receiving

surface does not have so important a bearing upon the fluorescent result obtained, since the opaque fluorescent materials act as reflectors of light in themselves. Thus, if a very opaque fluorescing ink be used, it may oftentimes be successfully printed upon a light-absorbing receiving surface such as colored paper stock.

A further modification of this method, which likewise makes possible the printing of fluorescent inks on light-absorbing colored receiving surfaces, requires the addition, before application of the fluorescent ink, of an agent such as lithopone, which is a good reflector of the light produced by the fluorescent agent. Such a mixture then acts independently of the colored background and reflects to the eye of the observer a high percentage of the light-emission produced by the fluorescent agent during exposure to fluorescigenous radiant energy.

Example 5.—As a further means of increasing the range of fluorescent colors available, and of accurately controlling the color and intensity of fluorescence on a duplicative reproduction impress, we may apply ink materials providing fluorescent agents as well as agents capable of absorbing certain wave-lengths of the light produced by the fluorescent agent during excitation with fluorescigenous radiant energy. For example, we may add a small amount of ultramarine blue pigment, ground in any convenient printing carrier such as linseed varnish, to a large amount of white fluorescing ink; the areas printed with such a combination ink throw off light which is deep blue in color rather than white upon exposure to filtered ultra-violet light. The ultramarine blue pigment performs the subtractive function of absorbing a part of the light-emission from the white fluorescing ink, and the additional function of reflecting the blue portion of the light-emission from the white fluorescing ink. In the same manner, we may add a small amount of non-fluorescent light-absorbing transparent yellow pigment, ground in a printing carrier, to a large amount of green fluorescing ink to obtain a resultant print which fluoresces lemon yellow.

Example 6.—It has been found in practice that a further important means of controlling the color and intensity of the light-emission from a duplicative fluorescent reproduction impress may be exercised by careful selection of a receiving surface capable of absorbing certain of the wave-lengths of light emitted by the fluorescing inks printed over that receiving surface. For instance, we may print a brilliantly fluorescing red ink over a carefully selected non-fluorescent light-absorbing light blue receiving surface to obtain an impress which fluoresces in a beautiful orchid or lavender. In this case, the light blue receiving surface absorbs certain of the longer wave-lengths of the light emitted by the red fluorescing inks, and reflects a large portion of the shorter wave-lengths, such as the blue.

Example 7.—A further refinement of our invention, related to another important means of controlling the color and intensity of fluorescence from a duplicative reproduction impress, entails the application of ink material providing fluorescent agents upon receiving surfaces which also receive impressions of non-fluorescent light-absorbing colored inks capable of absorbing certain of the wave-bands of light produced by the fluorescing areas. For instance, it may be necessary to produce a fluorescent print, certain sections of which must fluoresce yellow and other sec-

tions of which must fluoresce a grass green. This may be accomplished by first printing a non-fluorescent light-absorbing transparent green ink in multitudinous minute areas on that section of the paper which must fluoresce grass green in the finished print, and then printing multitudinous minute areas of yellow fluorescing ink over the light-absorbing green areas, the extent of superimposition in any given area depending upon the extent to which the fluorescent shade in that area must be altered toward the green side. The effect of this double printing on such sections of the reproduction will be a green or yellow-green fluorescence, as desired, since the non-fluorescent green areas will tend to absorb a portion of the light-emission from the yellow fluorescing ink, and largely reflect the green light emitted by same. Naturally, the desired intensity of yellow fluorescence on those sections of the print which must fluoresce yellow is obtained by printing yellow fluorescing ink alone, in minute areas of proper size and sufficient number.

Example 8.—We may further control the fluorescence of a reproduction impress by using a very carefully selected receiving surface which is itself fluorescent to the desired extent. For example, certain commercial yellow papers may be employed as some of them are fluorescent due to coloration during manufacture with a fluorescent dyestuff, such as tetramethyl-diamino-diphenylketonimine-hydrochloride. A paper so dyed will fluoresce green in filtered ultra-violet light, and if we over-print same with an orange fluorescing ink, the fluorescence of the resultant impress will be yellow; overprinting with blue fluorescing ink results in a cold white fluorescing impress. Rather intense light may be emitted by such a fluorescent paper during exposure to fluorescigenous radiant energy, and thus still another modified means of fluorescence control entails overprinting same with light-absorbing colored inks capable of absorbing certain selected wave-bands of the light emitted by the fluorescent surface. A non-fluorescent transparent blue ink printed over the above-described fluorescent receiving surface will modify the green fluorescence of the paper so that the resultant impress will fluoresce blue during exposure to fluorescigenous radiant energy.

Example 9.—It is sometimes advantageous to employ but one or two fluorescent inks in producing a luminescent reproduction which must exhibit a very wide range of different fluorescent tones during exposure to fluorescigenous radiant energy. To accomplish this end, the fluorescent ink is printed over a receiving surface likewise supporting impresses of a number of different light-absorbing colored inks capable of absorbing a variety of selected wave-bands of the light emitted by the fluorescent inks during said exposure. For example, we may print yellow, blue, and red non-fluorescent colored inks, and overprint with white fluorescing ink. Where the fluorescent ink is applied directly to the light-reflecting receiving surface, its fluorescence will be vivid white; it will fluoresce yellow where superimposed over the non-fluorescent yellow dots, deep blue where superimposed over the non-fluorescent blue dots, red where superimposed over the non-fluorescent red dots, etc.

It is to be understood that many omissions, alterations, and replacements in the procedures employed, materials used, and other phases of the invention described herein may be made by

those skilled in the nearest associated arts without departing from the intended broad spirit and scope of the invention; for example, considerable change is very often made in the particular sequence of the steps outlined in the above illustrative procedures. Likewise, it is obvious that the products of this invention may be varied widely, for example, receiving surfaces of fabric, metal, wood and other suitable materials may be substituted for paper. As a further example, luminescent reproduction of each different composition by different printing methods naturally necessitates wide variation in the physical characteristics of the plate, transfer, reticulated screen or other printing surface, to provide for the required number, size, thickness and positioning of the multitudinous minute dots, fine lines and other delicate and critical gradations of fluorescent inks. The printing of small quantities of luminescent impresses by such specialized methods as the silk screen printing process, for instance, is obviously within the comprehension of the invention.

We particularly point out and distinctly claim as our invention:

1. A process of making duplicate luminescent reproduction impresses which comprises the printing of fluorescent inks upon a receiving surface in fractional-tone structures, the quantities of which inks per unit of area are increased in accordance with any increase in fluorescence brightness desired and decreased in accordance with any decrease in fluorescence brightness desired, and the printing of non-fluorescent reproduction impresses in visible light absorbing inks upon the same receiving surface in selected areas substantially free of fluorescent inks.

2. A process of making duplicate reproductions which are luminescent in exposure to fluorescigenous radiant energy comprising the printing of ink materials providing fluorescent agents and agents capable of absorbing selected wave-bands of the visible light produced by the fluorescent agents during such exposure, upon a receiving surface in tone structures, the quantities of which ink materials per unit of area are substantially directly proportional in any given section of the print to the fluorescence brightness required in said section.

3. A process of making duplicative fluorescent reproductions comprising the printing of fluorescent inks upon a substantially non-fluorescent receiving surface, capable of absorbing selected wave-bands of the visible light produced in the applied fluorescent inks during exposure to fluorescigenous radiant energy, in tone structures, the quantities of which inks per unit of area are substantially directly proportional in any given section of the impress to the total visible light-emission required from said section during such exposure.

4. A process of making duplicative luminescent reproduction impresses of tonal subject matters comprising the application from mechanical supplying surfaces to a fluorescent receiving surface of multitudinous minute areas of ink materials providing agents capable of absorbing certain selected wave-bands of the light produced by the fluorescent surface during exposure to fluorescigenous radiant energy.

5. A process of making duplicative reproductions that are luminescent in exposure to fluorescigenous radiant energy comprising the printing of fluorescent inks in minute areas upon a receiving surface which supports multitudinous minute

areas of inks capable of absorbing selected wave-bands of the visible light produced by the applied fluorescent inks during said exposure, the quantities of which fluorescent inks per unit of area are substantially directly proportional in any given section of the print to the fluorescence brightness required in said section.

6. A process of making duplicative luminescent reproduction impresses which comprises the printing of fluorescent ink upon a receiving surface in fractional-tone structures covering a high percentage of the receiving surface in sections intended to appear as luminescent highlights and covering a comparatively low percentage of the sections intended to appear as darker luminescent shades, and the printing of non-fluorescent reproduction impresses in light absorbing inks upon selected areas of the same receiving surface.

7. A process of making duplicative reproductions which are luminescent in exposure to fluorescigenous radiant energy comprising the printing of fluorescent inks upon a receiving surface in discontinuous areas substantially the reverse of areas which would be coated with non-fluorescent inks in the orthodox color reproduction of the same subject matter, and the printing of non-fluorescent colored inks upon selected areas of the same receiving surface.

8. In a process of making duplicative reproductions which are luminescent in exposure to fluorescigenous radiant energy, the steps which comprise the printing upon discontinuous areas of a receiving surface of a relatively large volume of fluorescent ink per unit area of surface in sections designed to simulate luminescent highlights and other light shades and of a relatively small volume of fluorescent ink per unit of area in sections designed to simulate darker tones, and the printing of non-fluorescent colored inks in selected areas of the same receiving surface.

9. A process of making duplicative luminescent reproduction impresses which comprises the printing of fluorescent ink upon a receiving surface in numerous discontinuous areas in those sections required to represent luminescent highlights and in relatively few discontinuous areas in sections required to represent the darker fluorescent tones, and the printing of non-fluorescent impresses in light absorbing inks upon selected areas of the same receiving surface.

10. In a process of making duplicative reproductions which are luminescent in exposure to fluorescigenous radiant energy, the steps which comprise the heavy printing of fluorescent ink in sections of the receiving surface required to simulate highlights and other light shades during such exposure and the relatively light printing of fluorescent ink in tonal structures in sections representative of darker shades during said exposure, and the printing of non-fluorescent impresses in light absorbing inks upon selected areas of the same receiving surface.

11. A process of making duplicative luminescent reproductions of subject matters including tones comprising the printing of inks containing fluorescent agents upon selected areas of a receiving surface, the printing of non-fluorescent colored inks upon selected areas of the receiving surface substantially free of fluorescent ink, and the printing of fractional-tone structures over selected sections of the fluorescent impress with inks containing agents capable of absorbing selected wave-bands of the visible light produced

by the fluorescent agents during exposure to fluorescigenous radiant energy.

12. A process of making duplicative reproductions which are luminescent in exposure to fluorescigenous radiant energy comprising the printing of ink materials providing fluorescent agents and agents capable of absorbing selected wave-bands of the visible light produced by the fluorescent agents during such exposure upon a receiving surface in discontinuous areas covering a high percentage of the receiving surface in sections intended to appear as luminescent highlights and covering a comparatively low percentage of the receiving surface in sections intended to appear as darker luminescent shades during said exposure.

13. A process of making duplicative reproductions which are luminescent in exposure to fluorescigenous radiant energy comprising the printing of ink materials providing fluorescent agents and agents capable of absorbing selected wave-bands of the visible light produced by the fluorescent agents during such exposure upon a receiving surface in discontinuous areas substantially the reverse of areas of non-fluorescent inks which would be applied in the orthodox color reproduction of the same subject matter.

14. In a process of making duplicative reproductions which are luminescent in exposure to fluorescigenous radiant energy which comprises the printing of ink materials providing fluorescent agents and agents capable of absorbing selected wave-bands of the visible light produced by the fluorescent agents during such exposure, the step which comprises the printing upon discontinuous areas of the receiving surface of a relatively large volume of ink per unit area of surface in sections designed to simulate luminescent highlights and other light luminescent shades, and of a relatively small volume of ink per unit of area in sections designed to simulate the darker tones during said exposure.

15. A duplicative luminescent reproduction comprising an ink-receiving surface coated in selected areas with ink materials containing fluorescent agents to provide the luminescent highlights, coated in other selected areas with non-fluorescent colored inks to provide the dark shades during exposure of the print to fluorescigenous radiant energy, and having selected sections of the fluorescent impress overcoated in tonal structures with ink materials containing agents capable of absorbing selected wave-bands of the visible light produced by the fluorescent agents during said exposure to provide the intermediate tones.

16. A process of making duplicative fluorescent reproductions comprising the printing of fluorescent inks, upon a substantially non-fluorescent receiving surface chosen to absorb selected wave-bands of the visible light produced in the applied fluorescent inks during exposure to fluorescigenous radiant energy, in discontinuous areas the quantity of fluorescent ink in each discontinuous luminescent area being proportional to the visual luminescent brightness required for each of said discontinuous luminescent areas.

17. In a process of making duplicative reproductions which are luminescent in exposure to fluorescigenous radiant energy which comprises, the printing of fluorescent inks upon a substantially non-fluorescent receiving surface capable of absorbing selected wave-bands of the visible light produced in the applied fluorescent inks

during exposure to fluorescigenous radiant energy, the step which comprises the printing upon discontinuous areas of the receiving surface of a relatively large volume of ink per unit area of surface in sections intended to simulate luminescent highlights and other light shades and of a relatively small volume of ink per unit of area in sections intended to simulate the darker luminescent tones.

18. A process of making duplicative fluorescent reproductions comprising the printing of fluorescent inks upon a substantially non-fluorescent receiving surface capable of absorbing selected wave-bands of the visible light produced in the applied fluorescent inks during exposure to fluorescigenous radiant energy, in numerous discontinuous areas in those sections required to represent luminescent highlights and in relatively few discontinuous areas in sections required to represent the darker tones.

19. The process of making duplicate fluorescent reproductions comprising the step of printing on the receiving surface of each reproduction in the portions intended to appear as highlight sections a quantity of fluorescent ink in fractional-tone structures so that the quantity of ink per unit of area of a highlight section is substantially directly proportional to the visual brightness required in the unit of area of the highlight section when the reproduction is viewed under fluorescigenous radiations and the step of printing non-fluorescent ink on the receiving surface of each reproduction in selected portions intended to appear as darks and shadings related to the said highlight sections.

20. A duplicative luminescent reproduction comprising an article having an ink receiving surface, fluorescent ink printed in a fractional-tone structure in the portions of the surface intended to appear as the highlights of the reproduction when viewed under fluorescigenous radiations, the quantity of fluorescent ink per unit of area in any given highlight portion being in substantially direct proportion to the visual brightness required in the said unit of area of the highlight portion, and non-fluorescent ink printed on said surface in portions intended to appear as darks and shadings related to the said highlight portions.

21. As an article of manufacture, a duplicative luminescent reproduction comprising an article having an ink receiving surface, ink materials printed on said ink receiving surface in discontinuous areas covering a high percentage of said ink receiving surface in sections intended to appear as luminescent highlights and covering a comparatively low percentage of said ink receiving surface in sections intended to appear as darker luminescent shades, said ink materials comprising fluorescent agents and agents capable of absorbing selected wave-bands of the visible light produced by the fluorescent agents when said fluorescent agents are exposed to fluorescigenous radiant energy.

22. As an article of manufacture, a duplicative luminescent reproduction comprising an article having an ink receiving surface, fluorescent ink printed in discontinuous areas on said ink receiving surface, the quantity of fluorescent ink in each discontinuous luminescent area being proportional to the visual luminescent brightness required for each of said discontinuous areas, said receiving surface being substantially non-fluorescent and chosen to absorb wave-bands of

the visible light produced by said fluorescent ink during exposure to fluorescigenous radiant energy.

23. As an article of manufacture, a duplicative luminescent reproduction comprising an article having an ink receiving surface, multitudinous minute areas of ink supported on said surface and capable of absorbing selected wave-bands of visible light, minute areas of fluorescent inks printed on said surface and producing visible light when exposed to fluorescent energy, the quantities of said fluorescent ink per unit of area being substantially proportional in any given section of the reproduction to the fluores-

cent brightness required in that section of said luminescent reproduction.

24. As an article of manufacture, a duplicative luminescent reproduction comprising an article having a fluorescent receiving surface and ink materials printed on said fluorescent receiving surface in multitudinous minute areas, said ink material containing agents capable of absorbing selected wave-bands of light produced by said fluorescent surface during exposure of said fluorescent surface to fluorescigenous radiant energy.

ROBERT C. SWITZER.
JOSEPH L. SWITZER.

CERTIFICATE OF CORRECTION.

Patent No. 2,277,169.

March 24, 1942.

JOSEPH L. SWITZER, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 12, for "descreasing" read --decreasing--; page 6, first column, lines 26 and 38, claims 1 and 2 respectively, for "duplicate" read --duplicative--; page 8, second column, line 7, claim 24, for "multidinous" read --multitudinous--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of May, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.