No. 788,377. PATENTED APR. 25, 1905.

H. L. RECKARD.

PHOTOMECHANICAL PRINTING.

APPLICATION FILED JAN. 31, 1905.

Fig. 1

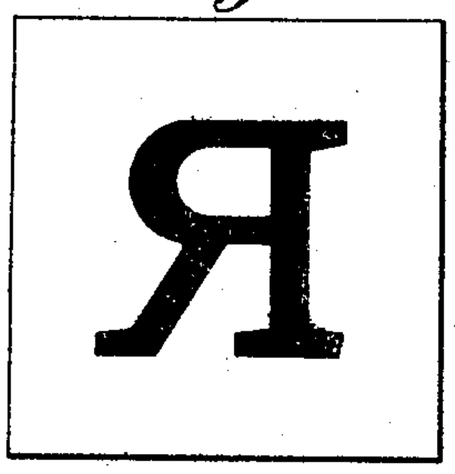


Fig. 2

Fig. 3

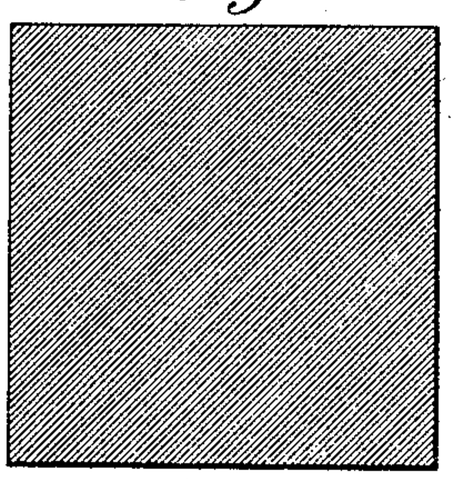


Fig. 4

Fig. 5

Fig. 6

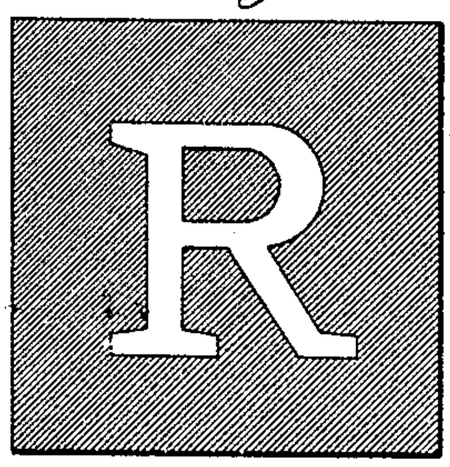


Fig. 7

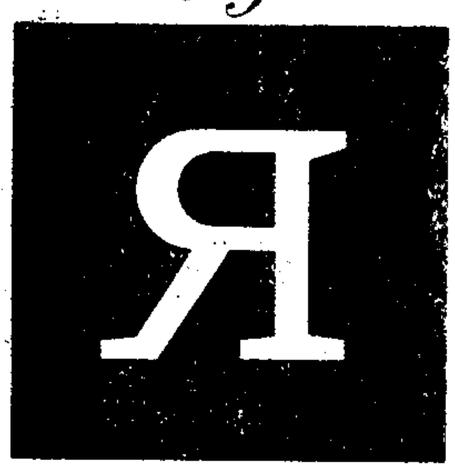


Fig. 8

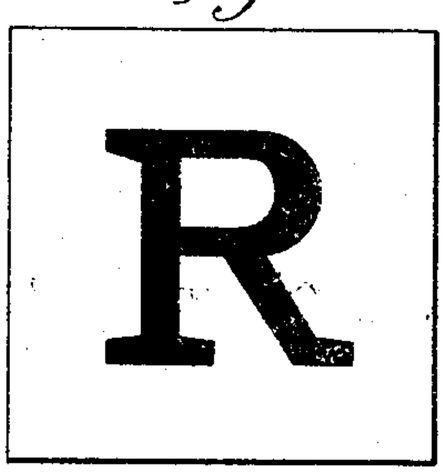


Fig. 9

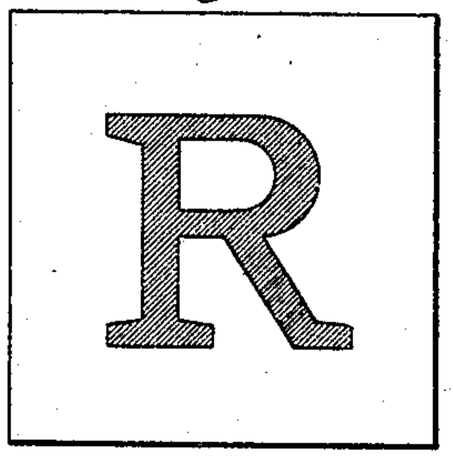


Fig. 10

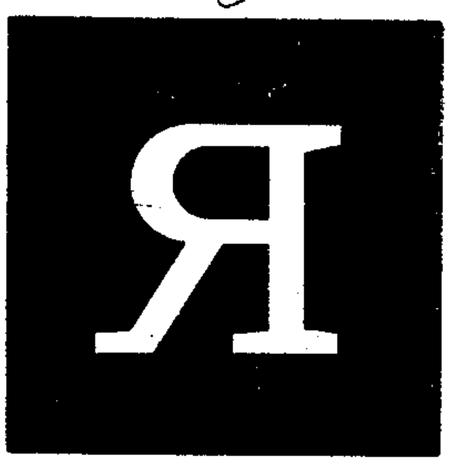


Fig. 11

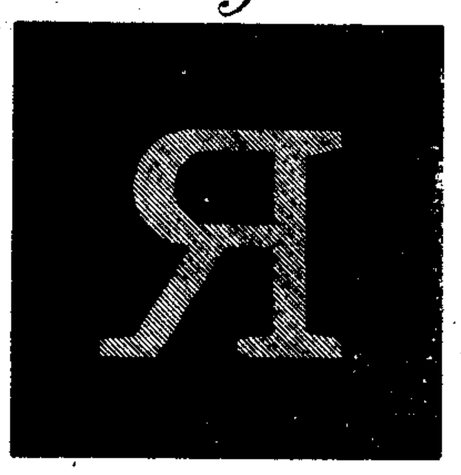


Fig. 12

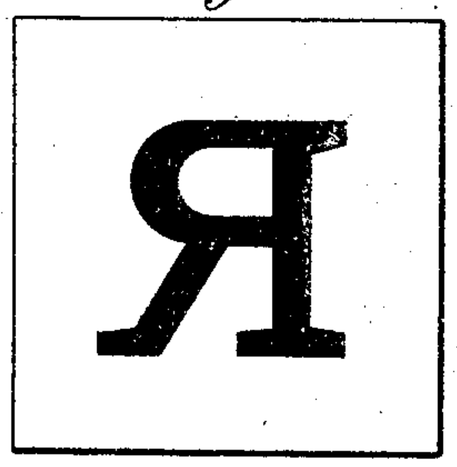
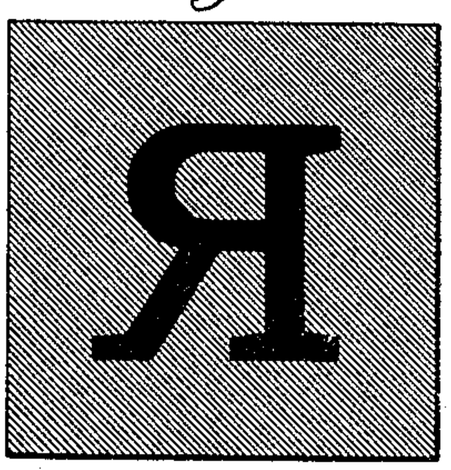
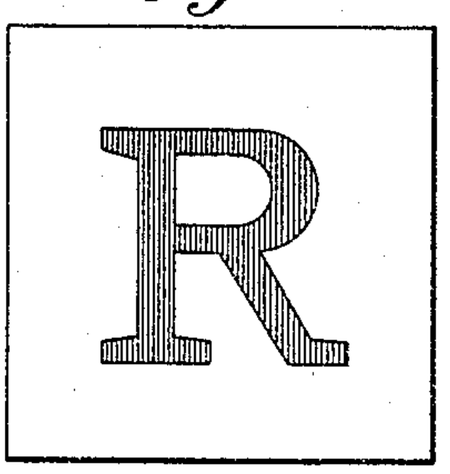
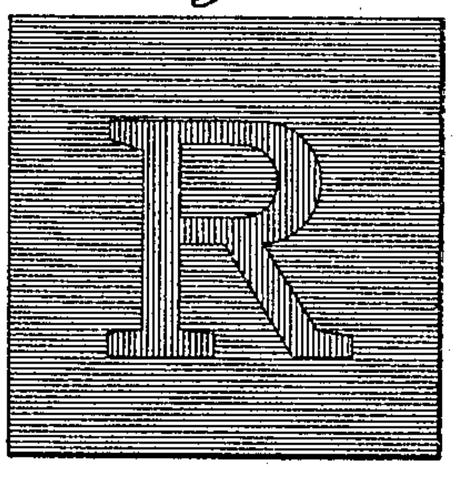


Fig. 13







Witnesses:

Chas. D. King.

Wilbur M. Stone

Henry L. Reckard
Inventor:

by Albert L. Walker.
Atty.

No. 788,377. Patented April 25, 1905.

UNITED STATES PATENT OFFICE.

HENRY L. RECKARD, OF NEW YORK, N. Y., ASSIGNOR TO ALBERT HENRY WALKER, TRUSTEE, OF NEW YORK, N. Y.

PHOTOMECHANICAL PRINTING.

SPECIFICATION forming part of Letters Patent No. 788,377, dated April 25, 1905.

Application filed January 31, 1905. Serial No. 243,453.

To all whom it may concern:

Be it known that I, HENRY L. RECKARD, a citizen of the United States, and a resident of Manhattan, New York, State of New York, have invented certain new and useful Improvements in Photomechanical Printing, of which the following description and claims constitute the specification and which are illustrated by the accompanying drawings.

The scope of my invention is broader than the following description and is properly defined in the following claims, the description setting forth one complete program for the practice of the invention, but not setting forth every program in which the invention may be practiced. Thus the description and the drawings primarily relate to a program for printing a design composed of two non-overlapping colors upon a strip of cloth by means of two accurately-registering intaglio copper rollers, while the invention is also applicable to some other programs. For example, it is applicable to printing a design composed of three or more non-overlapping colors upon a strip of cloth by means of a corresponding number of intaglio copper rollers and also to printing a design composed of two or three or more non-overlapping colors upon a strip of paper by means of a corresponding number of relief copper rollers or upon a sheet of paper by means of a corresponding number of relief-plates of copper or other metal.

Figure 1 of the accompanying drawings represents a transparent glass or celluloid sheet having the opaque reversed letter "R" thereon. Fig. 2 represents a developed gelatin plate, the background of which is in depression, and the letter "R," on which background is in relief, and which gelatin plate is produced, as hereinafter described, by instrumentalities which include the sheet of Fig. 1. Fig. 3 represents a transparent glass or celluloid sheet having fine parallel black lines drawn near together diagonally across it. Fig. 4 represents another developed gelatin plate identical with that of Fig. 2, except that its depressed background is occupied by parallel diagonal ridges represented by white spaces in Fig. 4 and which ridges are separated by grooves represented by black lines in that figure. Fig. 5 represents a thin transparent flexible celluloid sheet, the background of which is composed of opaque ink directly transferred thereto from the gelatin plate of Fig. 2. Fig. 6 represents a developed gelatin plate, the white background of which is in relief and the letter "R" of which is in depression. Fig. 7 represents a gelatin plate identical with that of Fig. 6, except that the depressed letter "R" thereon is composed of ridges and grooves instead of being in uniform depression. Fig. 8 represents the periphery of a copper roller No. 1, which has received a solid coat of etcher's ink over its black area from the gelatin plate of Fig. 2 and which periphery has been severed in imagination along a longitudinal line and has been imaginarily stripped from the roller and has been laid out flat, so as to present all parts of the area of the periphery to simultaneous view. Fig. 9 is identical with Fig. 8, except that it represents the periphery of roller No. 1 as having not only received a solid coat of etchers' ink like that shown in Fig. 8, but as also having received upon the surfaces which are uncovered in Fig. 8 an application from the plate of Fig. 7 of etcher's ink on the diagonal lines shown in Fig. 9. Fig. 10 represents the periphery of copper roller No. 2 provided with an application of etcher's ink from the letter "R" of the plate of Fig. 6 and which periphery is also represented in imagination as being severed along a longitudinal line and being flattened out so as to simultaneously present all portions of its surface to view. Fig. 11 is identical with Fig. 10, except that it represents the periphery of copper roller No. 2 as having not only received the letter "R" in etchers' ink, as shown in Fig. 10, but as also having received upon the surfaces which are uncovered in Fig. 10 an application from the plate of Fig. 4 of etcher's ink on the diagonal lines shown in Fig. 11. Fig. 12 is a view of a section of a continuous roll of cloth, upon which the letter "R" has been printed in red ink from copper roller No. 1. Fig. 13 is a view of the same section of cloth after the background

thereon has been added thereto by printing in blue ink thereon from copper roller No 2.

The program illustrated by the drawings is performed as follows: I produce the sheet shown in Fig. 1 of the drawings from a transparent glass or celluloid sheet by making the opaque reversed letter "R" thereon while making or leaving the background of the sheet transparent. The letter or other design on the sheet of Fig. 1 may be made thereon photographically or by the brush or pencil of an artist, and in the latter case the artist may paint or draw the design upon the transparent sheet as an original composition or may copy it from some other object or may trace it from a corresponding design on paper or cloth or other material, or the design may be applied to the transparent sheet in any one of several other ways, so as to produce the primary instrumentality employed in my invention, which primary instrumentality is a transparent sheet having some opaque design applied thereto. I also provide a transparent glass or celluloid sheet having fine parallel black lines drawn near together diagonally across it, which sheet is the instrumentality shown in Fig. 3 of the drawings. The fineness of those lines and their nearness together will be varied in different sheets of that kind, according to the requirements of different programs of printing, and those variations will generally range between fifty lines and spaces to an inch and a hundred lines and spaces to an inch.

The developed gelatin plate of Fig. 2 is made by the following means, in describing which I specify quantities by Troy weights: I dissolve one ounce of hard German gelatin in six ounces of water in a vessel of its own. I also dissolve one hundred and twenty grains of bichromate of ammonia in six ounces of water in a vessel of its own. Thereupon I add the solution containing bichromate of ammonia to the gelatin solution, and then I add three ounces of alcohol thereto, and then I filter the compound solution two or three times. The resulting composition of matter is a sensitized gelatin emulsion the ingredients of which I mix together and filter and keep in a dark room or in a room dimly lighted with red light.

I make a stock solution by mixing twenty-eight ounces of water and one hundred and eighty grains of citric acid and five hundred and twenty grains of nitrate of potassium and seventy grains of chrome-alum and half an ounce of liquid ammonia in a vessel of its own. I then take two unces of that stock solution and mix it with twelve ounces of glycerin and six ounces of water in a vessel of its own, and thus produce a glycerin solution. I next take a sheet of celluloid about one-fiftieth of an inch thick and provide it by means of a sand-blast or otherwise with a uniform finely-grained surface on each of its sides unless it is already so grained. I thoroughly clean this celluloid sheet with alcohol, and then I glue it down upon a perfectly-flat bright steel plate about a quarter of an inch thick by the following means: I take ordinary fish-glue and apply it to the upper surface of the steel plate by means of an inking-roller, and then I apply soft paper to that surface of the steel plate and press it down with a plain roller and leave it a few minutes to dry. Thereupon I apply more fish-glue to the upper surface of the paper, and then I press the celluloid sheet down upon that paper by means of a plain roller, taking care to exclude all air from between the celluloid and the steel. To confirm the union of the celluloid sheet with the steel plate through the intervention of the paper and the fish-glue, I pile the plate thus composed with other like plates with sheets of felt interposed between them, and then I put a weight upon the top of the pile and leave it there until each celluloid sheet is firmly and smoothly adherent to its steel plate. I next clean the celluloid side of the composite plate with alcohol, and I then pour my gelatin emulsion over that side of the plate, and then I place that plate with that gelatin emulsion thereon exactly horizontal in a drying-oven, and I leave it there until the gelatin emulsion is coherently dried and baked upon the celluloid surface. Thereupon I take the plate out of the oven and pour a second coat of the same gelatin emulsion on the first coat, and then I bake the plate as before. This production of a sensitive baked gelatin plate must be made in a dark room or in a room dimly lighted with red light, which light may come from an incandescent electric lamp having a red bulb or may be admitted to a dark room through a pane of red glass. The sensitive baked gelatin plate when finished must be kept dark and dry until it is used.

I treat my sensitive baked gelatin plate as follows, so as to produce therefrom the developed gelatin plate of Fig. 2: I put that sensitive baked gelatin plate in a photographic contact-frame with the sheet of Fig. 1 between it and the transparent front of the frame and with its face upon the gelatin plate. I then expose the baked gelatin plate to light passing through the sheet of Fig. 1 for spaces of time varying from four to ten minutes. The result of this exposure is to harden the different areas of the gelatin coating on the plate in proportion to the number of rays of light reaching those areas, respectively, through the different areas of the sheet of Fig. 1. As no rays of light will pass through the area covered by the opaque letter "R" on the sheet of Fig. 1, the corresponding area of the plate of Fig. 2 is not hardened; but as strong and uniform rays of light will pass through the transparent area of the sheet of Fig. 1 the corresponding area of the plate of Fig. 2 is uniformly hardened by the exposure. The

sensitive baked gelatin plate having been thus exposed to light is removed from the frame in a dark room and is immersed and bathed in that room, first in slightly-warm water and then in cool water. That bathing causes the absorption of water by the unhardened parts of the gelatin coating, and the absorbed water causes those parts of the gelatin coating to swell upward, and that swelling brings the letter "R" into relief on the gelatin surface, while leaving in depression the other parts of the surface of the gelatin plate. If I am working in a temperature above 65° Fahrenheit, I next bathe the gelatin plate for from three to five minutes in a solution of five drams of chrome-alum in twenty-four ounces of water; but this bathing is not necessary when I am working in a temperature as low as 60° Fahrenheit. The bathing of the gelatin plate in the solution of chrome-alum tends to prevent the swollen area of the gelatin from receding entirely down to the original horizontal level of the plate when the water is expelled from that swollen area by the drying of the plate by means of a current of air produced by an electric fan or otherwise and which drying is the next operation to which the plate is subjected. Still that drying causes the swollen area of the gelatin plate to somewhat recede; but the gelatin coating under that area remains comparatively soft and porous, while the gelatin coating under the depressed surface of the plate continues to be comparatively hard and dense.

I strip the celluloid base of the developed gelatin plate of Fig. 2, together with its gelatin coating, away from the steel plate to which the celluloid base was glued before the gelatin emulsion was applied thereto, for the steel plate has now performed its function of enabling me to keep the celluloid sheet perfectly flat and perfectly level while the gelatin emulsion was being baked thereon.

The developed gelatin plate of Fig. 4 is made by the same means as the developed gelatin plate of Fig. 2, except that the transparent sheet of Fig. 3 is placed in the photographic contact-frame face downward over the sheet of Fig. 1 when the sheet of Fig. 1 is placed in such a frame over a baked gelatin plate. The result of thus using the transparent sheet of Fig. 3 consists in the fact that while light passes through the white lines of that sheet it is intercepted by the black lines thereof and in the fact that the black lines of the sheet of Fig. 3 thus protect the sensitive gelatin coating under them from the hardening which would result if those lines were absent, and thus cause corresponding parallel ridges to rise upward from the bottom of what would otherwise be the uniformly-depressed background of the developed gelatin plate of Fig. 4.

The flexible celluloid sheet of Fig. 5 is made as follows: I apply the above-described glycerin solution to the flexible developed gelatin plate of Fig. 2. That solution adheres to and is absorbed by the relief parts of that plate, because they are porous, but is repelled by its depressed parts, because they are hard. I then remove the surplus glycerin from that flexible developed gelatin plate by means of tissue-paper applied thereto and removed therefrom, and I repeat this operation, if necessary, until no free glycerin solution remains upon any surface of the plate. I next apply printing-ink to the flexible developed gelatin plate of Fig. 2 by a soft and elastic inking-roller or by a succession of such rollers, which ink is taken by the depressed surfaces of that plate; but it is not taken by its relief-surfaces, because it is repelled therefrom by the glycerin solution thereon. The ink which is thus applied to the plate is composed by melting together one pound of asphaltum, one pound of rosin, half a pound of beeswax, one pound of mastic, and three ounces of mutton tallow, and then mixing that composition with double its quantity of the crayon-ink of commerce, which crayon-ink is made of cooked linseed-oil and lampblack without any fat. I then take a thin sheet of flexible transparent celluloid and press it upon the inked plate of Fig. 2, and thus transfer the ink from that plate to that sheet, and thus produce a naked reversed letter "R" upon that sheet, and then I complete the opaqueness of the background of that sheet by applying asphalt or graphite powder thereto with a ball or bunch cotton. This completes the sheet of Fig. 5.

The developed gelatin plate of Fig. 6 is made by the same means as the developed gelatin plate of Fig. 2, except that in making the plate of Fig. 6 I use the sheet of Fig. 5 instead of the sheet of Fig. 1 in the photographic contact-frame with a sensitive baked gelatin plate under it. This use of the sheet of Fig. 5 instead of the sheet of Fig. 1 results in making the letter "R" of the plate of Fig. 6 in depression and its background in relief instead of contrariwise, as is the case with the developed gelatin plate of Fig. 2.

The developed gelatin plate of Fig. 7 is made by the same means as that of Fig. 6, except that in this case I place the lined sheet of Fig. 3 over the flexible celluloid sheet of Fig. 5 in the photographic contact-frame, and thus ultimately produce diagonal ridges across what would otherwise be the uniformly-depressed letter "R" of the plate of Fig. 7 and which diagonal ridges are represented by the white spaces between the black lines on the letter "R" of the sheet of that figure.

At this point of the present program the sheets of Figs. 1, 3, and 5 have performed their functions, and the developed gelatin plates of Figs. 2, 4, 6, and 7 have been produced for use in the further performance of the program. That program proceeds with the preparation of copper roller No. 1 to do its share

of the printing, which is the ultimate object of the whole program, and it continues still further by the preparation of copper roller No. 2 to do its share in that printing, and it concludes with the successive use of copper rollers Nos. 1 and 2 in accomplishing that printing.

I prepare copper roller No. 1 in the following manner: I take the developed gelatin plate of Fig. 2, which may or may not have been used in producing the flexible celluloid sheet of Fig. 5, and I apply the above-described glycerin solution to its relief parts unless those parts are already sufficiently provided with that solution, and in case a new application is made I remove the surplus glycerin from that flexible developed gelatin plate by means of tissue-paper applied thereto and removed therefrom. I next apply printing-ink to the flexible developed gelatin plate of Fig. 2 by a soft and elastic inking-roller or by a succession of such rollers, which ink is taken by the depressed surfaces of that plate; but it is not taken by its relief-surfaces, because it is repelled therefrom by the glycerin solution thereon. The ink which is thus applied to the plate is the same kind of ink which is above described as being applied to the same plate when that plate is about to be used to produce the flexible celluloid sheet of Fig. 5. Thereupon I roll a plain copper roller having a finely-roughened periphery over the inked plate of Fig. 2 with pressure enough to cause sufficient ink to be transferred from the inked surface of the plate to the corresponding part of the periphery of the roller. Thereupon I change that ink into an enamel by means of the application thereto of an enameling-powder and by means of heat. That enameling-powder is composed of two parts of rosin, one part of shellac, and two parts of alcohol, melted together and then cooled and finely pulverized. I apply that powder with a cotton ball to the inked surface of the copper roller, so as to make the powder adhere to the inked portions of that surface without adhering to the naked portions thereof. Then I heat the copper to a temperature high enough to melt the enameling-powder into the ink to which it has adhered. This heating results in changing the ink on the surface of the copper roller into an enamel, and that enamel will protect those areas of the copper roller covered thereby from the eating of the etching liquid, which is subsequently applied to the copper roller. Copper roller No. 1 having been thus provided with a coat of enamel on the surfaces represented by the black areas in Fig. 8, I next provide the still naked letter "R" thereon with diagonal lines of etcher's ink, such as those shown in Fig. 9. This result is accomplished as follows: I strip the celluloid base of the developed gelatin plate of Fig. 7, together with its gelatin coating, away from the steel plate to which that celluloid base was glued before the gelatin emulsion was applied thereto. Thereupon I apply the above-described glycerin solution to the now flexible developed gelatin plate of Fig. 7 and remove the surplus glycerin therefrom, as I did in the case of the flexible developed gelatin plate of Fig. 2. I next apply the same kind of ink to that plate that I applied to the plate of Fig. 2; but that ink instead of being taken by the background of the plate is taken instead by the grooves between the ridges of the letter "R" in the plate of Fig. 7. Thereupon I roll the copper roller No. 1 with accurate registration over the inked flexible plate of Fig. 7, and thus transfer ink from the depressed grooves of the letter "R" of that plate to the naked letter "R" of copper roller No. 1, so as to apply to that letter the black diagonal lines shown in Fig. 9. I next protect the interior of the roller, if it is hollow, and also its ends with asphalt varnish from the action of the etching liquid, which I next apply to the periphery of the roller. I make that application by simply causing the roller to rotate above a pan containing the etching liquid and with all portions of the periphery of the roller successively passing through the etching liquid in the pan as the roller is rotated. That etching liquid, which may be chlorid of iron, eats into the naked portions of the periphery of the copper roller and more slowly eats into the lined portions thereof, which are covered with etcher's ink, while not affecting those portions of that periphery which are covered by the enamel. I cause the etching liquid to do its etching work for a greater or less length of time, according as I intend to etch more or less deeply into the periphery of the copper roller, and thus give more or less relief to the unetched surface. After the periphery of the copper roller has been etched I wash it with water to remove the etching solution, and then I remove the enamel from its relief-surface with turpentine.

I prepare copper roller No. 2 in the same manner as copper roller No. 1; but in preparing copper roller No. 2 I successively prepare and use the flexible developed gelatin plates of Figs. 6 and 4 instead of using the flexible developed gelatin plates of Figs. 2 and 7. Copper rollers Nos. 1 and 2 having been thus provided with the printing areas shown in lines in Figs. 9 and 11, respectively, red "color" is applied to the grooves between the ridges represented by those lines in copper roller No. 1, and blue color is applied to the grooves between the ridges represented by those lines in copper roller No. 2. That application is made by applying those colors to the entire peripheries of those rollers, respectively, and by scraping the surplus color away from their plain surfaces. The function of the ridges in the depressions on the peripheries of the printing-surfaces of copper

rollers Nos. 1 and 2, respectively, is to prevent the scraper from descending to the flat bottoms which would exist in those depressions in the absence of those ridges and from thus removing the color from those depressions as well as from the plain relief-surfaces of the rollers. The ridges are diagonal instead of being parallel to the axis of the rollers because it is necessary that the edge of the scraper shall never be parallel with the ridges in the depressions on the peripheries of the rollers, and the ridges are made lower than the plain surfaces of the rollers in order that the edges of the plain surfaces may be continuous and also to insure the application of color to the entire cloth surfaces opposite to the printing depressions of the rollers, including the low ridges in those depressions as well as the grooves between those ridges. The rollers being thus provided with their respective colors, a strip of cloth is drawn between copper roller No. 1 and an opposite plain roller and then between copper roller No. 2 and a plain roller opposite thereto, and those rollers are so rotated that their printing-surfaces will register accurately upon that strip of cloth. Although the color is only or mainly in grooves in the depressions on the peripheries of each of the rollers and is therefore applied only or mainly in lines corresponding with those grooves to the surface of the cloth, the color will spread by capillary attraction over the narrow spaces between those lines and will thus result in a continuous application of red color from the roller No. 1 to constitute a flat red letter "R" and also a continuous application of blue color from the roller No. 2 to constitute a flat blue background for that letter.

The word "transparent" in the foregoing description is used to designate the desired degree of transmissibility of light; but the sheets and plates which are said in the description to be transparent may be only translucent, though in that case the sensitive baked-gelatin plates thereunder will require longer exposure to light through those translucent sheets than they would if the latter were strictly transparent.

The sheets of Figs. 1 and 3 of the drawings are said in the description to be glass or celluloid, and they may be rigid or flexible and they may be made of some other translucent or transparent material than celluloid or glass. If the sheet of Fig. 1 is thick, the sheet of Fig. 3 should be thin and should be placed face downward between the sheet of Fig. 1 and the sheet of Fig. 2 in the photographic contact-frame instead of over the sheet of Fig. 1, and if the sheet of Fig. 3 is thick the sheet of Fig. 1 should be thin and should be placed face downward between the sheet of Fig. 3 and the sheet of Fig. 2 in that frame.

Flexible celluloid sheets are said in the description to be the foundations of the developed gelatin plates of Figs. 2, 4, 6, and 7; but I claim that any other material which will perform the same function in substantially the same way is equivalent to celluloid for that purpose. Each of the flexible gelatin plates of Figs. 2, 4, 6, and 7 is said in the description to be temporarily glued down upon a rigid steel plate while the gelatin plate is being baked and also while it is being exposed to light and also while it is being bathed in water; but such a flexible gelatin plate may be made without ever being glued down upon any rigid plate, and if such a flexible gelatin plate is glued down upon a rigid plate while it is being baked that plate may be of some other metal than steel or may be glass, and that flexible gelatin plate may be stripped from that rigid plate before it is exposed to light or after it is exposed to light and before it is bathed in water instead of being kept upon the rigid plate until after it is bathed in water. The gelatin plate with its flexible base should be stripped from a metal plate before the glycerin solution is applied thereto in order to avoid any chemical reaction between any of the chemicals in the glycerin solution and the metal of the rigid plate; but if glass is used instead of metal for the rigid plate the gelatin plate, with its flexible base, may be left on the rigid plate until after the glycerin solution is applied to the gelatin plate, and, indeed, until after the gelatin plate is inked; but the developed and inked gelatin plate should be stripped from any rigid plate to which it may have been glued before ink is transferred from the gelatin plate to a copper roller, because the gelatin plate should be elastic at that time. That elasticity is necessitated by the fact that the copper roller must be pressed very hard down upon the inked gelatin plate in order to transfer enough ink from the depressions in the plate to the periphery of the roller and by the fact that that hard pressure would crush or distort the relief-surfaces of the gelatin plate if the base of that plate were rigid at that time. The flexibility of that base at that time is made available to prevent such crushing or distortion by means of the presence below that base of some cushioning material, such as felt or soft rubber.

Each of the gelatin plates of Figs. 2, 4, 6, and 7 may be made upon a flat and rigid plate instead of upon a flexible sheet, provided such a flat and rigid plate is furnished on its upper surface with an elastic layer of rubber or other elastic material, on the upper side of which layer the gelatin emulsion is spread and upon which it is dried or baked. The rigid foundation of such a gelatin plate may be glass and may be a quarter of an inch thick or more. A layer of elastic material—such as soft vulcanized rubber, leather, or cardboard—may be spread over with a rubber solution and then fastened down upon such a rigid foundation

by drying that adhesive substance. Thereupon the elastic side of the plate thus composed may be coated with a solution of water-glass and albumen and that solution may be dried on that surface, so as to give to the elastic side of the plate an insoluble and porous surface for the reception of the gelatin emulsion and the firm retention of the gelatin film.

When a rigid plate like that described in the last paragraph is used instead of a flexible celluloid sheet as the foundation of a gelatin plate, that gelatin plate will retain that foundation through all the stages of its manufacture and use, including the transference of ink from its developed gelatin surface to the copper roller which is rolled over it for the reception of that ink. When that rolling occurs, the elastic layer between the gelatin surface and the rigid foundation of the plate will yield enough to enable the copper roller to take ink from all the depressions in that gelatin surface without crushing or distorting the relief portions thereof.

The function of the parallel ridges which rise upward from the bottom of what would otherwise be the uniformly-depressed background of the developed gelatin plate of Fig. 4 and also the parallel ridges which rise upward from what would otherwise be the uniformly-depressed letter "R" of the developed gelatin plate of Fig. 7 consists in confining the ink-receiving portions of those plates to the grooves between those ridges, and the function of those grooves consists in applying ink to diagonal lines across the background of copper roller No. 2 and across the letter "R" of copper roller No. 1. The function of those diagonal lines of ink on the copper rollers can be performed in some cases by ink applied to the same surfaces in dots or stipple, for when ink is thus applied it protects the copper under it from the etching liquid, and thus causes peaks of copper to rise upward from the bottoms of what would otherwise be the uniformly-depressed surfaces of the copper rollers, and those peaks of copper will perform the same function as parallel ridges of copper on the same surfaces.

Ink can be applied to the unetched copper rollers in dots or stipple instead of in parallel lines by making pits for its reception instead of parallel grooves in the bottoms of the depressed surfaces of the gelatin plates of Figs. 4 and 7, and those pits can be made by making those plates with a sheet having two series of fine parallel lines crossing each other at right angles or diagonally or with a sheet otherwise made opaque throughout except in having small transparent areas regularly or irregularly arranged thereon instead of with the sheet of Fig. 3.

The function of the grooves or pits on the background of the gelatin plate in Fig. 4 and on the letter "R" of the gelatin plate of Fig. 7 can also be accomplished by irregular cracks made in the bottoms of those depressed surfaces, respectively. Those cracks can be produced by making the gelatin plates of Figs. 4 and 7 with a gelatin emulsion like that hereinbefore described except in having from two hundred to three hundred grains of chlorid of calcium added thereto.

When I am to make the gelatin plates of Figs. 4 and 7 with irregular cracks instead of parallel grooves in the depressed surfaces thereof, I use the gelatin emulsion with calcium instead of using the gelatin emulsion without calcium, which I still use in making the gelatin plates of Figs. 2 and 6; but otherwise I proceed in making the gelatin plates of Figs. 4 and 7 in the same way as in making the gelatin plates of Figs. 2 and 6, respectively. The presence of calcium in the gelatin emulsion causes another result to follow from the exposure to light and the bathing in water of the baked gelatin plates which I use in making the developed gelatin plates of Figs. 4 and 7 in addition to the result which follows from such exposure and bathing of the baked gelatin plates which I use in making the developed gelatin plates of Figs. 2 and 6. That other result consists in numerous eruptions on those portions of the surfaces of those plates which were under the transparent portions of the sheets of Figs. 1 and 5 when those plates were exposed to light through those sheets, respectively.

The eruptions which were developed by the water in the depressed surfaces of the developed gelatin plates of Figs. 4 and 7 result in making irregular cracks in those surfaces. Many of those cracks intersect with each other; but some of them are isolated from the others. The average size of the cracks can be varied by varying the proportion of the chlorid of calcium used in the gelatin emulsion and also by varying the time of exposure of the baked gelatin plates to light under the sheets of Figs. 1 and 5, respectively. I continue to bathe the gelatin plates of Figs. 4 and 7 in water until all the potential cracks are developed therein and until the bichromate of ammonia or other sensitizing chemical is so far eliminated from the gelatin that the plates can be exposed to dim light without any further change taking place therein or thereon; but I keep the plates away from ordinary light until after they are dried.

Having thus produced two developed gelatin plates identical with those of Figs. 4 and 7, respectively, except in having irregular cracks instead of regular grooves or regular pits in the depressed surfaces of those plates, I use those plates in the further prosecution of the program in the same way that I have already explained how to use the plates of Figs. 4 and 7 in doing their share toward producing the copper rollers Nos. 1 and 2, respectively. Those irregular cracks are separated from each other by irregular ridges,

and when I apply the glycerin solution to those plates that solution is taken by those ridges, but is repelled by those cracks, and when after removing the surplus glycerin solution from those plates I apply etcher's ink thereto that ink is taken by those cracks while it is repelled by those ridges. Thereupon when I roll the copper rollers Nos. 1 and 2 over those inked developed gelatin plates ink is transferred from the cracks in the depressed surfaces of those plates to the corresponding surfaces of those rollers respectively, and thus what would otherwise be the naked letter "R" of copper roller No. 1 and what would otherwise be the naked background of copper roller No. 2 are provided with irregular deposits of ink separated from each other by narrow and correspondingly irregular naked surfaces. Thereupon when the etching liquid is applied to copper rollers Nos. 1 and 2 it eats into those irregular naked surfaces and more slowly eats into those portions to which those irregular deposits of etcher's ink have been applied, while not affecting those portions of the peripheries of those rollers which are covered by the enamel and which enamel is represented by the black surfaces of Figs. 9 and 11. Those portions of the peripheries of the rollers which were partly protected from the etching liquid by the irregular deposits of ink thereon will be left irregular peaks rising upward from what would otherwise be the uniformly-depressed surfaces of those rollers, and those peaks will perform the same function as the regular ridges which will result from the printing on those rollers of the parallel lines shown in Figs. 9 and 11.

I can sometimes omit the application of ink in parallel lines or in regular or irregular local deposits on those surfaces of the copper rollers which are shown with such lines in Figs. 9 and 11. That omission can be effected by omitting to use the lined plate of Fig. 3 or any substitute therefor and by omitting to make or use the gelatin plates of Figs. 4 and 7 and by leaving the letter "R" on the copper roller No. 1 naked, as shown in Fig. 8, instead of applying parallel lines thereto, as shown in Fig. 9, and by leaving the background of copper roller No. 2 naked, as shown in Fig. 10, instead of applying parallel lines thereto, as shown in Fig. 11. The result of this modification of the program will consist in the letter "R" on copper roller No. 1 being a uniform depression on the periphery of that roller and will consist in the background of copper roller No. 2 being a uniform depression on the periphery of that roller instead of having those depressions of those rollers occupied by low parallel ridges or regular or irregular peaks extending upward from the bottoms thereof. The absence of those ridges and peaks will necessitate some other provision for preventing the scraper from removing the color from those depressions while it is removing the color from the relief-surfaces of those rollers, respectively, and that prevention can sometimes be accomplished by making the edge of the scraper so straight and so stiff that it will be held out of those depressions by the relief-surfaces of those rollers.

The program for preparing two relief copper rollers for printing two non-overlapping colors upon a strip of paper differs in the following particulars from the described program for preparing two intaglio copper rollers for printing two non-overlapping colors upon a strip of cloth. The sheet of Fig. 3 and the plates of Figs. 4 and 7 are not made or used, and the copper roller No. 1 does not receive any ink upon its naked letter "R" shown in Fig. 8, and the copper roller No. 2 does not receive any ink upon its naked background shown in Fig. 10, so that those rollers never assume the appearance shown in Figs. 9 and 11, respectively. The absence of any deposit of ink from the letter "R" on copper roller No. 1 causes the etching liquid to uniformly eat away that portion of the periphery of that roller to any desired depth, and the absence of any deposit of ink from the background of copper roller No. 2 causes the etching liquid to uniformly eat away that background to any desired depth. After the peripheries of those rollers have been thus etched and have been washed with water to remove the etching solution and have been treated with turpentine to remove the enamel from their unetched surfaces those surfaces are in relief and are represented by the black background of Fig. 8 and the black letter "R" of Fig. 10, respectively. Copper rollers Nos. 1 and 2 having been thus provided with those plain surfaces in relief, red ink is applied to the relief letter "R" of copper roller No. 2 and blue ink is applied to the relief background of copper roller No. 1 by means of hard gelatin inking-rollers, which do not deposit any ink upon the depreesed surfaces of those copper rollers, respectively. Those copper rollers being thus provided with their respective colors of ink, a strip of paper is drawn between copper roller No. 2 and an opposite plain roller and then between copper roller No. 1 and a plain roller opposite thereto, and those rollers are so rotated that their printing-surfaces will register accurately upon that strip of paper. Thus the red letter "R" will appear to be printed upon a blue background on that paper, as shown in Fig. 13, and that printing will be repeated on that strip of paper as many times as the two inked rollers are rotated thereon.

The rollers Nos. 1 and 2 are said in the description to be copper; but they may be made of any one of several other metals or amalgams, with varying results in respect of cost, durability, and goodness.

The claims which conclude this specification define my invention in terms applicable

to the photographic preparation and the mechanical use of two metal rollers or plates for printing; but my invention is likewise applicable to the preparation and use of any number of such rollers or plates greater than two and not greater than the number of different colors or shades or different forms of colored surfaces which may practically be printed by a corresponding number of metal rollers or plates harmoniously together upon a strip or sheet of cloth or paper. That applicability involves some increases in number and some variations in use of the transparent sheets and gelatin plates used in preparing the metal rollers or plates for etching; but those increases or variations do not require a detailed description in this specification. Whenever three or more metal rollers or plates are prepared or are prepared and used in accordance with the terms of my claims plus those proper increases of numbers and variations of use, the particular programs of those claims will be practiced as truly as when only two metal rollers or plates are thus prepared or prepared and used, as the case may be.

I claim as my invention—

1. The following process of photomechanical printing: making four sensitive gelatin plates on elastic and flexible celluloid bases, which are temporarily glued down upon flat and horizontal plates, while the gelatin is setting: exposing two of those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively, one of which counterpart sheets is made photographically from the other: exposing the other two of those sensitive gelatin plates to light through those two partly-transparent and partly-opaque counterpart sheets, respectively, and contemporaneously through an opaque sheet provided with fine transparent lines or small transparent areas: developing those four exposed gelatin plates by bathing them in water and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those four developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of the first pair of those gelatin plates, respectively, to the corresponding respective surfaces of two metal rollers or plates: transferring ink from the depressed and grooved or pitted surfaces of the second pair of gelatin plates, respectively, to the corresponding respective surfaces of the same two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different colors to the depressed and grooved or pitted surfaces of those metal rollers or plates: transferring color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

2. The following process of photomechanical printing: making four sensitive gelatin plates on elastic and flexible celluloid bases: exposing two of those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively, one of which counterpart sheets is made photographically from the other: exposing the other two of those sensitive gelatin plates to light through those two partly-transparent and partly-opaque counterpart sheets, respectively, and contemporaneously through an opaque sheet provided with fine transparent lines or small transparent areas: developing those four exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those four developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of the first pair of those gelatin plates, respectively, to the corresponding respective surfaces of two metal rollers or plates: transferring ink from the depressed and grooved or pitted surfaces of the second pair of gelatin plates, respectively, to the corresponding respective surfaces of the same two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different colors to the depressed and grooved or pitted surfaces of those metal rollers or plates: transferring color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

3. The following process of photomechanical printing: making four sensitive gelatin plates on elastic bases: exposing two of those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively, one of which counterpart sheets is made photographically from the other: exposing the other two of those sensitive gelatin plates to light through those two partly-transparent and partly-opaque counterpart sheets, respectively, and contemporaneously through an opaque sheet provided with fine transparent lines or small transparent areas: developing those four exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those four developed gelatin plates in air: applying glycerin solution to

the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of the first pair of those gelatin plates, respectively, to the corresponding respective surfaces of two metal rollers or plates: transferring ink from the depressed and grooved or pitted surfaces of the second pair of gelatin plates, respectively, to the corresponding respective surfaces of the same two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different colors to the depressed and grooved or pitted surfaces of those metal rollers or plates: transferring color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

4. The following process of photomechanical printing: making four sensitive gelatin plates on elastic and flexible celluloid bases, which are temporarily glued down upon flat and horizontal plates, while the gelatin is setting: exposing two of those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively: exposing the other two of those sensitive gelatin plates to light through those two partly-transparent and partly-opaque counterpart sheets, respectively, and contemporaneously through an opaque sheet provided with fine transparent lines or small transparent areas: developing those four exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those four developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of the first pair of those gelatin plates, respectively, to the corresponding respective surfaces of two metal rollers or plates: transferring ink from the depressed and grooved or pitted surfaces of the second pair of gelatin plates, respectively, to the corresponding respective surfaces of the same two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different colors to the depressed and grooved or pitted surfaces of those metal rollers or plates: transferring color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

5. The following process of photomechanical printing: making four sensitive gelatin plates on elastic and flexible celluloid bases: exposing two of those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively: exposing the other two of those sensitive gelatin plates to light through those two partly-transparent and partly-opaque counterpart sheets, respectively, and contemporaneously through an opaque sheet provided with fine transparent lines or small transparent areas: developing those four exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those four developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of the first pair of those gelatin plates, respectively, to the corresponding respective surfaces of two metal rollers or plates: transferring ink from the depressed and grooved or pitted surfaces of the second pair of gelatin plates, respectively, to the corresponding respective surfaces of the same two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different colors to the depressed and grooved or pitted surfaces of those metal rollers or plates: transferring color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

6. The following process of photomechanical printing: making four sensitive gelatin plates on elastic bases: exposing two of those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively: exposing the other two of those sensitive gelatin plates to light through those two partly-transparent and partly-opaque counterpart sheets, respectively, and contemporaneously through an opaque sheet provided with fine transparent lines or small transparent areas: developing those four exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those four developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of the first pair of those gelatin plates, respectively, to the corresponding respective surfaces of two metal rollers or plates: transferring ink from the depressed and grooved or pitted surfaces of the second pair of gelatin plates, respectively, to the cor-

responding respective surfaces of the same two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different colors to the depressed and grooved or pitted surfaces of those metal rollers or plates: transferring color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

7. The following process of photomechanical printing: making two sensitive gelatin plates on elastic and flexible celluloid bases, which are temporarily glued down upon flat and horizontal plates, while the gelatin is setting: exposing those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively, one of which counterpart sheets is made photographically from the other: developing those exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of those gelatin plates, respectively, to the respective surfaces of two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different-colored inks or colors to those metal rollers or plates: transferring ink or color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

8. The following process of photomechanical printing: making two sensitive gelatin plates on elastic and flexible celluloid bases: exposing those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively, one of which counterpart sheets is made photographically from the other: developing those exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of those gelatin plates, respectively, to the respective surfaces of two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different-colored inks or colors to those metal rollers or plates: transferring ink or color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

9. The following process of photomechanical printing: making two sensitive gelatin plates on elastic bases: exposing those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively, one of which counterpart sheets is made photographically from the other: developing those exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of those gelatin plates, respectively, to the respective surfaces of two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different-colored inks or colors to those metal rollers or plates: transferring ink or color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

10. The following process of photomechanical printing: making two sensitive gelatin plates on elastic and flexible celluloid bases, which are temporarily glued down upon flat horizontal plates while the gelatin is setting: exposing those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively: developing those exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of those gelatin plates, respectively, to the respective surfaces of two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different-colored inks or colors to those metal rollers or plates: transferring ink or color from those rollers or plates successively, and with mutual registration, to whatever fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

11. The following process of photomechan-

ical printing: making two sensitive gelatin plates on elastic and flexible celluloid bases: exposing those sensitive gelatin plates to light, through two partly-transparent and partly-opaque counterpart sheets, respectively: developing those exposed gelatin plates by bathing them in water, and thereby swelling some parts of their surfaces into more or less relief, while leaving other parts of their surfaces in more or less depression: drying those developed gelatin plates in air: applying glycerin solution to the relief-surfaces of those developed gelatin plates: applying ink to the depressed surfaces of those developed gelatin plates: transferring ink from the depressed surfaces of those gelatin plates, respectively, to the respective surfaces of two metal rollers or plates: etching away the naked surfaces of those two metal rollers or plates: applying different-colored inks or colors to those metal rollers or plates: transferring ink or color from those rollers or plates, successively, and with mutual registration, to whaetver fabric, paper or other material constitutes the base of the colored print which results from the process: all substantially as described.

HENRY L. RECKARD.

Witnesses:

ALBERT H. WALKER,

NARCISO C. DONATO.