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J. W. IPPERS.

PHOTOMECHANICAL PRINTING.

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Fig. 1

IPPERTYPE

Fig. 2

Fig. 3

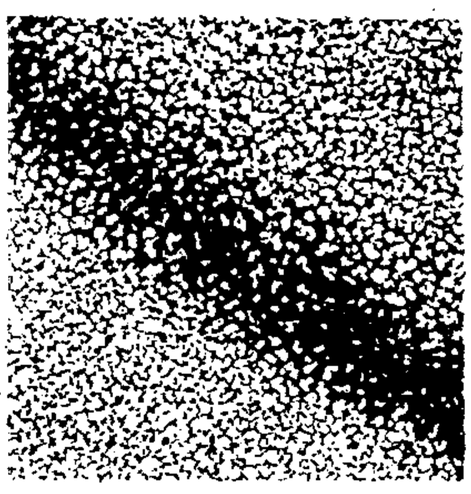
IPPERTYPE

Fig. 4

Fig. 5

IPPERTYPE

Fig. 6



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UNITED STATES PATENT OFFICE.

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PHOTOMECHANICAL PRINTING.

SPECIFICATION forming part of Letters Patent No. 785,735, dated March 28, 1905.

Application filed December 30, 1904. Serial No. 238,928.

To all whom it may concern:

Be it known that I, JOHN W. IPPERS, a subject of the German Emperor, and a resident of the city of 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 improvements complete a system which I have named "Ippertype printing."

The object of my invention is to make pictures of natural or artificial subjects with graduated deposits of printing-ink in relief-printing, intaglio-printing, or planographic printing and by a process which includes photographic means and mechanical means without hand drawing or engraving and without any half-tone screen.

The nature of my invention consists in making a sensitive gelatin plate on a flexible celluloid base and having a gelatin coat of uniform thickness and in exposing that sensitive gelatin plate to light through a translucent picture and in developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular and irregularly-distributed cracks in its surface and swelling some parts of its surface into more or less relief, while leaving some parts of its surface more or less in depression, and in drying that developed gelatin plate in air, and in afterward using that plate in producing relief, intaglio, or planographic printing surfaces.

Figures 1, 2, 3, 4, and 5 of the drawings illustrate the transformations from positives to negatives and from negatives to positives and also the shiftings from right to left and from left to right, which occur in my process; but those figures do not represent the numerous irregular cracks which are made in the developed gelatin plate of Fig. 3 nor the characteristic relief, intaglio, or planographic printing surfaces of Fig. 4, which result from those cracks, nor the gradations of printed surfaces of Fig. 5, which result from the use of those characteristic printing-surfaces in applying black ink to white paper. Those cracks and their separate results are too minute to be analytically represented unmagnified in any drawing made with a pen; but Fig. 6 of the drawings represents them in black ink and magnified ten diameters in size, so that their character can be seen with the naked eye.

Assuming that the object of which I am to print a photomechanical picture is a business sign on the front elevation of a building, consisting of the word "Ippertype" on a white ground, and reading from left to right, as in Fig. 1 of the drawings, and composed of letters having surfaces graduated in structureless paint from nearly black through various shades of gray to nearly white, I first make a photographic negative of that sign upon the face of which negative the sign is reversed, so as to read from right to left, as in Fig. 2 of the drawings, while the letters composing the sign are variably translucent on an opaque ground. Then I place that photographic negative face downward upon a sensitive baked-gelatin plate having a flexible celluloid base, and I expose the gelatin plate to light through the negative, and I afterward develop that sensitive gelatin plate by bathing it in water. The result is to produce upon the surface of the developed gelatin plate a representation of the sign, with the name reading in the original direction from left to right and with those portions of the surface of the developed gelatin plate in relief which were under the opaque ground of the negative, while those portions of the developed gelatin plate which were under the variably-translucent letters of the negative are more or less in depression, and which depressions contain numerous irregular cracks irregularly distributed over those portions of the developed gelatin plate. Such a developed gelatin plate is illustrated by Fig. 3, the black letters of that figure being representative of those cracked depressions and its white ground being representative of the plain relief portions of the plate. Thereupon I roll ink upon the surface of the

developed gelatin plate and fill its cracks with more or less ink in proportion to their respective widths. I then press the inked gelatin plate face downward upon a plain copper plate in a printing-press, with the result of transferring the ink from the inked gelatin plate above to the copper plate below. Upon removing the gelatin plate a positive reproduction of the sign will be seen upon the copper plate, with the name reading from right to left, as in Fig. 4 of the drawings, and with the letters of the name composed of graduated surfaces, though the ink thereon is not continuous, but consists of separate and irregular deposits of ink made from the irregular cracks in the gelatin plate, and which deposits, like the cracks from which they came, are irregularly distributed. Afterward I etch away the uninked portions of the surface of the copper plate, as hereinafter described, and I thus produce a copper plate with a reproduction of the sign represented in relief-surfaces thereon, but reading from right to left, as in Fig. 4, and which relief-surfaces comprise numerous irregular and irregularly-distributed peaks and ridges of copper. I then roll ink upon the copper plate and take an impression from its relief-surfaces on white paper, and I thus produce a paper-impression which is a positive picture of the original sign and is represented by Fig. 5 of the drawings. The letters in this picture present to the naked eye the same effect as the graduated but structureless letters of the original sign, because the irregular and irregularly-distributed deposits of ink which constitute these letters are so minute that the naked eye does not see them separately and recognizes only their combined and structureless effect.

In making a photographic negative of the subject of which I am about to produce a photomechanical picture I prefer to make that negative upon a dry photographic plate; but I can use a wet photographic plate for that purpose, though sometimes with an inferior result.

In making a flexible sensitive baked gelatin plate I proceed according to the following description, in which description I specify quantities by troy weights: I dissolve two ounces of hard German gelatin in twelve ounces of water and four ounces of alcohol in a vessel of its own. I also dissolve one hundred and fifty grains of bichromate of ammonia, fifty grains of bichromate of potash, and thirty grains of chromic acid in six ounces of water in a vessel of its own. I also dissolve two hundred and eighty grains of chlorid of calcium and fifty grains of common salt in six ounces of water in a vessel of its own. Thereupon I first add the solution containing bichromate of ammonia to the gelatin solution, and then I add the solution containing chlorid of calcium to the composition, and, lastly, I add forty drops of liquid ammonia thereto, and then I filter the compound solution two or three times. The resulting composition of matter is a sensitized gelatin emulsion which for the purpose of this specification I designate as my "gelatin emulsion No. 1," and 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 next take a sheet of translucent 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 process: I apply common fish-glue 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 there a few minutes to dry. Thereupon I apply the same kind of 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-bubbles 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 No. 1 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 No. 1 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. Instead of thus making and using my gelatin emulsion No. 1 I sometimes make and use another gelatin emulsion, which, for the purpose of this specification, I designate as my "gelatin emulsion No. 2" and which I compose by a program similar to that used in making gelatin emulson No. 1, but the ingredients of which gelatin emulsion No. 2 are twenty-two ounces of water, three ounces and six drams of gelatin, eight-

een ounces of alcohol, three drams of bichromate of potash, two drams of chromic acid, two drams of common salt, one dram of nitrate of silver, half a dram of chrome-alum, and fifty drops of liquid ammonia.

When I use my gelatin emulsion No. 2, I pour it over the celluloid side of the composite plate above described and then I place that plate, with the gelatin emulsion thereon, exactly horizontal in an oven and leave it there until the gelatin emulsion is coherently dried and baked upon the celluloid surface of the composite plate. In this case I do not pour a second coat of the gelatin emulsion upon the first coat, and I proceed to use my sensitive baked-gelatin plate with one coat of my gelatin emulsion No. 2 baked thereon in the same general way that I use the above-described baked gelatin plate which is made with two successive coats of gelatin emulsion No. 1.

I use either of my sensitive baked-gelatin plates as follows: I put such a plate in a photographic contact-frame, with a photographic negative or other translucent picture of the object to be reproduced between it and the transparent front of the frame. I then expose the baked-gelatin plate to light passing through the translucent picture for spaces of time varying from four to ten minutes. One result of this exposure consists in some chemical change occurring at definite points in the gelatin coating of the plate. That change is mainly due to the presence of chlorid of calcium, bichromate of potash, and common salt in my gelatin emulsion No. 1, and in my gelatin emulsion No. 2 it is mainly due to the presence therein of the bichromate of potash and the common salt. That change is more or less positive and complete in proportion to the number of rays of light which reach the different areas of the gelatin coating through the different areas of the translucent picture above them. Another 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 translucent picture. The sensitive baked-gelatin plate having been thus exposed to light is removed from the frame in a dark room and is developed in that room by being bathed first in slightly-warm water and then in cool water, and that developing produces the following two results: The first result consists in numerous eruptions in the surface of the coating of the developed gelatin plate, which eruptions are primarily due to the chlorid of calcium, the bichromate of potash, and the common salt in the gelatin emulsion No. 1 and to the presence in the gelatin emulsion No. 2 of the bichromate of potash and the common salt, and which eruptions are directly due to the chemical change which occurred in the gelatin coating on account of the presence of those chemicals therein at the time the baked-gelatin plate was exposed to light through the translucent picture. Those eruptions are distributed irregularly over the surface of the developed gelatin plate, being less numerous and less wide in those parts of the gelatin coating which were under the darker parts of the translucent picture than in those parts of the gelatin coating which were under the lighter parts of the translucent picture in the photographic contact-frame, because the eruptive tendency of the different particles of the chlorid of calcium, bichromate of potash, and common salt in the gelatin coating is in direct proportion to the amount of light reaching those particles, respectively. The eruptions which are developed by the water in the gelatin coating result in making irregular cracks, more or less wide and more or less near together, over the entire surface of the gelatin coating, the wider and more frequent cracks developing in those parts of the gelatin coating which were under the lighter parts in the translucent picture and the narrower and more infrequent cracks being developed in those parts of the gelatin coating which were under the darker parts of the translucent picture in the contact-frame. Many of these 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 chemicals used in the gelatin emulsion and also by varying the time of exposure of the baked-gelatin plate to light under the translucent picture, and some of those chemicals in some proportions produce cracks with greater sharpness and angularity of outline than some other chemicals in some other proportions.

The second result of bathing the exposed gelatin plate in water consists in the absorption by the gelatin coating of varying quantities of water in the different parts of that coating, which quantities of water are in inverse proportion to the hardening of the different parts of the gelatin coating by the varying number of rays of light which reached those different parts through the translucent picture above them. The absorbed water causes the gelatin coating to swell more or less at different portions of its areas, which swelling brings more or less into relief different parts of the surface of the gelatin plate in proportion to the quantity of water absorbed by the gelatin coating under those different surfaces and which swelling leaves depressions more or less deep in those parts of the surface of the gelatin plate which absorb the lesser quantities of water. Thus the view of the translucent picture is reproduced in relief upon the developed gelatin plate, the darker parts of the translucent picture being represented by those parts of the surface of the developed gelatin plate which are in relief,

while the lighter parts of the translucent picture are represented by those parts of the developed gelatin plate which are in depression, and the parts in relief and the parts in depression shading into each other more or less gradually, as did the light parts and the darker parts of the translucent picture.

The foregoing description of the two results which occur from bathing the exposed gelatin plate in water refers particularly to cases wherein the translucent picture through which the sensitive gelatin plate was exposed to light has no perfectly opaque area and no perfectly transparent area, but where its translucency is decidedly variable. In case that translucent plate has a perfectly opaque area the corresponding surface of the developed gelatin plate will be in plain and comparatively high relief, without the characteristic cracks. In case that translucent plate has a perfectly transparent area the corresponding surface of the developed gelatin plate will be in comparatively deep depression, and the cracks in the bottoms of that depression will practically constitute part of the depression and will not be separately represented on the printing-surface, which is made on metal or stone with the developed gelatin plate. In case the translucent picture has no perfectly opaque nor any perfectly transparent area, and where its translucency is but slightly variable, the developed gelatin plate will have but little relief and but little depression other than its characteristic cracks, and which cracks will alone represent the picture by their varying widths and frequencies of distribution.

I continue to bathe the gelatin plate 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 plate can be exposed to dim light without any further change taking place therein or thereon; but I keep the gelatin plate away from ordinary light till after the drying stated in the next paragraph.

If I am working in a temperature above 65° Fahrenheit, I next bathe the developed 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 developed plate in the solution of chrome-alum tends to permanently fix the walls and outlines of the cracks on the surface of the plate and also to prevent the swollen areas of the gelatin from receding entirely down to the original horizontal level of the plate when the water is expelled from those swollen areas 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 areas of the gelatin plate to somewhat recede; but the gelatin coating under those areas remains comparatively soft and porous, while the gelatin coating under the depressed surfaces of the plate continues to be comparatively hard and dense. Having thus produced my developed gelatin plate with a view potentially represented thereon by the varying degrees of density and porosity of its gelatin coating, as well as by some of the areas being in relief and other areas being in depression, and which coating has the characteristic cracks which I have described distributed irregularly over its surface, with the wider, deeper, and more frequent cracks in the lower and denser parts of the gelatin coating and with the narrower, shallower, and less frequent cracks in the more porous and elevated parts of the gelatin coating, I proceed as follows: I prepare 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 ounces 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 strip the gelatin part of my composite developed gelatin plate, together with its celluloid base, 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 necessary function of enabling me to keep the celluloid sheet perfectly flat and perfectly level while the gelatin emulsion was being baked thereon and has also performed its convenient function of enabling me to keep the celluloid sheet perfectly flat while bathing, developing, and drying the baked gelatin plate. Thereupon I apply the above-described glycerin solution to the developed gelatin plate. That solution adheres to and is absorbed by those areas of that plate which are comparatively porous, but is repelled by those areas of that plate which are comparatively hard, and is also repelled by the interior of the cracks over the whole plate. I then remove the surplus glycerin solution from the developed gelatin plate by means of tissue-paper applied thereto and removed therefrom, and I repeat this operation, if necessary, until none of the solution remains upon any of the surface of the plate or in any of the cracks therein. I next apply a particular lithographic printing-ink to the developed gelatin plate by a proper inking-roller or by a succession of such rollers, which ink is taken by the comparatively hard areas of the gelatin plate and by the cracks on the surface of that plate; but

it is not taken by the comparatively porous areas of the plate, because it is repelled therefrom by the glycerin solution therein. The ink which is thus applied to my gelatin plate is composed by melting together one pound of asphaltum, one pound rosin, half a pound of beeswax, one pound 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. Having thus rolled up my developed gelatin plate with ink, I place that plate face downward upon a sand-blasted or otherwise finely-roughened surface of a copper plate, and then I apply enough pressure to the back of the inked flexible gelatin plate to transfer the ink from its face to the copper plate, but without using pressure enough to crush any part of the gelatin coat on the flexible base or to otherwise injure the picture which is thus transferred from the gelatin plate to the copper plate. Thereupon I carefully remove the flexible gelatin plate from the copper plate and then proceed as follows: I prepare an enameling-powder 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 fine powder with a cotton ball to the inked surface of the copper plate, 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 plate into a hard enamel, and that enamel will perfectly protect those areas of the copper plate covered thereby from the eating of the etching liquid, which is subsequently applied to the copper plate. Before applying that etching liquid I paint the back of the copper plate with asphalt-varnish to protect the back of the plate from the etching liquid. That etching liquid may be chlorid of iron, and it will eat away the naked portions of the face of the copper plate, while not affecting those portions of that surface 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 desire to etch the copper plate more or less deeply, and thus give more or less relief to the printing-surface of the resulting printing-plate. I sometimes etch so deeply that the relief portions of the plate are used as the printing-surface thereof; but in some cases I etch less deeply and use the depressed portions of the plate as its printing-surface. After the copper plate has been etched I wash it with pure water to remove the etching solution, and then I remove the enamel from its relief-surface with turpentine.

My invention is applicable to printing in combinations of colors as well as in one color only. For example, I can make three photographic negatives of an oil-painting upon three dry photographic plates through a proper color-screen for each negative, and I can make a flexible developed gelatin plate from each of those negatives, and I can print from each of those flexible gelatin plates upon a separate copper plate, and I can enamel and etch each of those copper plates as above described, and I can then apply to each of those copper plates its proper color of ink, and I can finally make a colored copy of the oil-painting by successively printing from those three copper plates upon paper or other suitable material.

My invention is also applicable to printing either in one color or in several colors with one copper roller or with a separate copper roller for each of the several colors, as the case may be.

When I am to prepare and use the periphery of a copper roller to print in one color upon paper, I make, develop, and ink a flexible gelatin plate, as above described. Thereupon I roll a plain copper roller having a finely-roughened surface over that flexible inked gelatin plate with downward pressure sufficient to cause the ink on the gelatin plate to be transferred to the periphery of the roller. Thereupon I change that ink into an enamel by means of the application of the same enameling-powder which I use upon copper plates and by means of heat, and I protect the interior of the roller, if it is hollow, or its ends, if it is solid, from the action of the etching liquid which I apply to the periphery of the roller. I make that application by causing the roller to revolve on its own axis 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 turned on its own axis. The etching liquid thus applied eats away the naked portions of the periphery of the copper roller, while not affecting those portions of the periphery which are covered by the enamel. In this case, as in the case of a copper plate, I cause the etching liquid to do its etching-work for a greater or less length of time, according as I desire to etch the periphery of the copper roller more or less deeply, and thus give more or less relief to the unetched surface. I generally etch so deeply that the relief portions of the periphery of the roller are used as the printing-surface thereof; but in some cases I etch less deeply and use the depressed portions of its periphery as that printing-surface. After the periphery of the copper roller has been etched I wash it with pure water to remove the etching solution, and then I remove the enamel from its relief surface with turpentine. The periphery of a copper roller having been thus provided with a print-

ing-surface; the roller is used in a printing-machine as if it had received its printing-surface from the hands of an engraver.

When I am to prepare and use the periphery of a copper roller to print in one color upon woven fabric, I proceed the same as when I am to use the periphery of a copper roller to print in one color upon paper, except that when printing upon fabric I use the depressed portions of the roller for the printing-surfaces instead of using the relief portions thereof and except that in order to produce a positive picture from the depressed portions of the roller I print through a positive translucent picture instead of a negative translucent picture upon the baked gelatin plate in the contact-frame and except that I sometimes make an original translucent negative, from which the translucent positive is taken through a prism in order that the positive picture printed upon the fabric by the roller may have the same right and left direction as the original object which that picture represents.

I can also provide the peripheries of three or more copper rollers with contributory printing-surfaces by means of three or more such developed, inked, and flexible gelatin plates as I have above described in connection with the production of three or more copper printing-plates for the successive printing of three or more different colors, and I can use those printing-rollers successively to produce a picture composed of a combination of those colors.

A copper plate or a copper roller which has been provided on the plan of this specification with a surface in relief has that surface mainly composed of minute irregular peaks and ridges of varying widths and frequencies and constantly-changing directions, and which peaks and ridges result from those irregular cracks in the flexible developed gelatin plate which were described in an earlier paragraph of this specification. These peaks and ridges result from those cracks, because those cracks are filled with ink when ink is rolled upon the developed gelatin plate and because the ink is transferred from those cracks to the surface of the copper plate or to the periphery of the copper roller, as the case may be, and being afterward changed into an enamel on that surface it protects the copper below it from the etching fluid, and therefore leaves that copper in relief in the form of peaks and ridges surrounded by depressions.

Where a copper plate or copper roller is so etched as to use its relief areas for its printing-surface, those peaks and ridges receive ink, while the depressions around them do not; but where a copper plate or a copper roller is so etched as to use its depressed areas for its printing-surface the depressions around the peaks and ridges receive ink, while the peaks and ridges themselves are not thus provided. Whether the peaks and ridges receive ink, while the depressions around them do not, or whether the depressions receive ink, while the peaks and ridges around them do not, the peaks, ridges, and depressions taken together constitute a fine granular printing-surface on the plate or roller, as the case may be. That granular surface varies through every degree of difference between areas almost entirely covered with ink and areas almost entirely free from ink.

Thus the definite printing points and areas which I make upon a copper plate or a copper roller and which are necessary to the printing utility thereof are so distributed over the surface of the copper as to combine to reproduce the lights and shades of original pictures with their own respective and undiminished values, and that distribution is accomplished in ipper-type printing by light and chemistry, automatically coöperating to faithfully imitate the object to be reproduced.

Where the translucent picture through which my sensitive gelatin plate is exposed to light is a photograph, that photograph may be a negative or may be a positive, the choice between the two depending on whether the relief parts or the depressed parts of the ultimately resulting etched metal surface are to be used as the printing parts of the surface of the metal plate or roller which is prepared for printing by my process. So, also, the translucent picture through which a sensitive gelatin plate is exposed to light in my process may be a picture made by the brush or pencil of an artist on a sheet of glass or in any one of several other ways, so as to produce the instrumentality which I specify as a "translucent" picture. By that designation I include all pictures which are variably translucent, whether or not they are quite transparent and quite opaque in some of their areas.

Flexible celluloid sheets are said in the specification to be the foundation of my flexible gelatin plates, though I claim that any other flexible sheet which will perform the same function in substantially the same way will be equivalent to a celluloid sheet for that purpose; but I know of no other material which can perform the same function in substantially the same way, and I think that no sheet of metal, paper, cloth, cardboard, soft rubber, hard rubber, wood, or leather can be used as an equivalent of a flexible celluloid sheet as a foundation for my flexible gelatin plate.

Each of my flexible celluloid sheets is said in the description to be temporarily glued down upon a flat and horizontal steel plate while the gelatin coat is being coherently dried and baked thereon. This flat and horizontal condition and position of the celluloid base causes the gelatin coat to set and dry upon the celluloid base with uniform thick-

ness throughout all parts of its area, and that uniformity of thickness of the gelatin coat is essential to the performance of the function of my gelatin plate.

The flat plate upon which the flexible celluloid sheet is glued down while the gelatin coat is setting and drying thereon may be of some other metal than steel, or it may be glass. The flexible celluloid sheet, with its gelatin coat, may be stripped from that flat 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 flat plate until after it is bathed in water. If the flat plate is metal, the gelatin plate, with its flexible celluloid base, should be stripped from the flat plate before the glycerin solution is applied to the gelatin coat in order to avoid any chemical reaction between the metal of the flat plate and any of the chemicals in the glycerin solution; but if the flat plate is glass, the gelatin plate, with its flexible celluloid base, may be left on the flat plate until after the glycerin solution is applied to the gelatin plate and, indeed, until after the gelatin plate is inked.

Before ink is transferred from the inked gelatin plate to a solid surface the inked gelatin plate should be stripped from any flat plate to which it may have been glued, because the gelatin plate should be flexible at that time. That flexibility is necessitated by the fact that the inked gelatin plate must be pressed very hard against the solid surface in order to transfer ink enough from the depressions in the gelatin plate to the solid surface and by the fact that that hard pressure would crush or distort the relief parts of the surface of the gelatin plate if the base of that plate were rigid at that time and by the fact that good ink impressions cannot be made between two unyielding plates or other bodies. The flexibility of that base at that time is made available to prevent such crushing or distortion and to produce good ink impression by means of the presence below that base of some cushioning material, such as felt or soft rubber.

My described improvements in photomechanical printing are capable of some variations in some respects; but they have several distinguishing characteristics which are indispensable. One of those distinguishing characteristics is the peculiar flexibility of the base for the gelatin plate, and another is the uniform thickness of the gelatin coat upon the sensitive gelatin plate before it is developed, and another is the presence of numerous irregular cracks in the surface of the developed gelatin plate.

Flexibility alone is not a sufficient characteristic of the base of my gelatin plate, for other characteristics must coexist with that flexibility. For example, the flexible sheet must be easy to bend, like celluloid, and not hard to bend, like steel, and it must, like celluloid, be quite elastic, and not inelastic, like lead. Moreover, the flexible sheet which constitutes the base of the gelatin plate must be incapable of expansion or contraction, like paper or wood, or of diagonal distortion, like cloth, during its immersion in water or during its preceding or subsequent handling, for any one of these capabilities would result in distorting the gelatin coat, and that distortion would spoil, or at least injure, any resulting independent picture and would prevent proper registration between the printing-surfaces of two or more copper rollers or copper plates when those surfaces were produced from a corresponding number of gelatin plates made from the same original subject. Furthermore, the flexible sheet must be free from capability of chemical reaction with any of the chemicals in the gelatin emulsion applied thereto or with any of those in the glycerin solution applied to the developed gelatin plate, and most metal sheets are unavailable for this reason alone.

Uniform thickness of the gelatin coat upon the gelatin plate before it is developed is necessary to enable the light to act upon the cracking chemicals in the different parts of the gelatin coat in exact proportion to the translucency of the parts of the translucent picture through which the light is shining upon the gelatin coat during the exposure of the gelatin plate to light. In the absence of this characteristic the resulting picture would be spoiled by streaks or clouds, due to some groups of the cracks being too numerous or too few or too wide or too narrow to correspond with the graduated surfaces which they should respectively represent.

Numerous irregular cracks are necessary in the depressed parts of my developed gelatin plate in order to deposit ink from those cracks in irregular areas on the copper surface which is to be etched, while leaving naked other irregular areas around those deposits, and that combination of inked and uninked irregular areas on that copper surface is necessary in both relief-printing and intaglio-printing of graduated pictures in order to produce by subsequent etching of the copper surface a printing-surface capable of producing graduated deposits of ink upon paper, and the same combination of inked and uninked irregular areas on the copper surface is additionally necessary in intaglio-printing in order to produce numerous minute ridges and peaks of copper, extending upward from the bottoms of the depressions etched into the copper and serving to prevent the removal of the ink from those depressions by the cloth or other wiper which must be used to wipe away the ink from the relief portions of the same copper surface.

A relief or an intaglio printing surface can be made on aluminium, zinc, or other metal by the means set forth in this specification, except that different metals are best etched with different etching liquids, and a planographic surface can be made on stone or on zinc by means which include the process of my claim 3 and include also such other means as would be employed if a picture were to be put upon the surface of the stone or zinc by the pen of an artist instead of being printed thereon with ink with one of my flexible developed gelatin plates.

I claim as my invention—

1. The following process of photomechanical printing: making a sensitive gelatin plate, on a flexible celluloid base, which base is temporarily glued down upon a flat and horizontal plate while the gelatin is setting: exposing that sensitive gelatin plate to light through a translucent picture: developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular, and irregularly-distributed cracks in its surface: drying that developed gelatin plate in air: stripping that gelatin plate, with its flexible base, away from that flat plate: applying glycerin solution to those parts of the surface of that developed gelatin plate which will take it: applying ink to the other parts of the surface of that developed gelatin plate: transferring ink from that inked flexible gelatin plate to a metal surface, by pressing the inked flexible gelatin plate directly against the metal surface: etching away the uninked parts of that metal surface: applying printing-ink to the printing parts thus produced on that metal surface: and transferring ink from those printing parts directly to the surface of whatever material constitutes the base of the picture which results from the process: all substantially as described.

2. The following process in photomechanical printing: making a sensitive gelatin plate, on a flexible celluloid base, which base is temporarily glued down upon a flat and horizontal plate while the gelatin is setting: exposing that sensitive gelatin plate to light through a translucent picture: developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular, and irregularly-distributed cracks in its surface: drying that developed gelatin plate in air: stripping that gelatin plate, with its flexible base, away from that flat plate: applying glycerin solution to those parts of the surface of that developed gelatin plate which will take it: applying ink to the other parts of the surface of that developed gelatin plate: transferring ink from that inked flexible gelatin plate to a metal surface, by pressing the inked flexible gelatin plate directly against the metal surface: and etching away the uninked parts of that metal surface: all substantially as described.

3. The following process in photomechanical printing: making a sensitive gelatin plate, on a flexible celluloid base, which base is temporarily glued down upon a flat and horizontal plate while the gelatin is setting: exposing that sensitive gelatin plate to light through a translucent picture: developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular, and irregularly-distributed cracks in its surface: drying that developed gelatin plate in air: stripping that gelatin plate, with its flexible base, away from that flat plate: applying glycerin solution to those parts of the surface of that developed gelatin plate which will take it: applying ink to the other parts of the surface of that developed gelatin plate: and transferring ink from that inked flexible gelatin plate to a solid surface, by pressing the inked flexible gelatin plate directly against the solid surface: all substantially as described.

4. The following process in photomechanical printing: making a sensitive gelatin plate, on a flexible celluloid base, which base is temporarily glued down upon a flat and horizontal plate while the gelatin is setting: exposing that sensitive gelatin plate to light through a translucent picture: developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular, and irregularly-distributed cracks in its surface: drying that developed gelatin plate in air: and stripping that gelatin plate, with its flexible base, away from that flat plate: all substantially as described.

5. The following process in photomechanical printing: making a sensitive gelatin plate, on a flexible celluloid base, having a gelatin coat of uniform thickness: exposing that sensitive gelatin plate to light through a translucent picture: developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular, and irregularly-distributed cracks in its surface: drying that developed gelatin plate in air: applying glycerin solution to those parts of the surface of that developed gelatin plate which will take it: applying ink to the other parts of the surface of that developed gelatin plate: transferring ink from that inked flexible gelatin plate to a metal surface, by pressing the inked flexible gelatin plate directly against the metal surface: and etching away the uninked parts of that metal surface: all substantially as described.

6. The following process in photomechanical printing: making a sensitive gelatin plate, on a flexible celluloid base, having a gelatin coat of uniform thickness: exposing that sensitive gelatin plate to light through a translucent picture: developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular, and irregularly-distributed cracks in its surface: drying that developed gelatin plate in air: applying glycerin

solution to those parts of the surface of that developed gelatin plate which will take it: applying ink to the other parts of the surface of that developed gelatin plate: and transferring ink from that inked flexible gelatin plate to a solid surface, by pressing the inked flexible gelatin plate directly against the solid surface: all substantially as described.

7. The following process in photomechanical printing: making a gelatin plate, on a flexible celluloid base, having a gelatin coat of uniform thickness sensitized with bichromate of ammonia and chlorid of calcium: exposing that sensitive gelatin plate to light through a translucent picture: developing that exposed gelatin plate by bathing it in water, and thereby making numerous irregular, and irregularly-distributed cracks in its surface: and drying that developed gelatin plate in air: all substantially as described.

JOHN W. IPPERS.

Witnesses:
ALBERT H. WALKER,
HENRY L. RECKARD.