May 8, 1934. E. BASSIST 1,957,433

METHOD OF MAKING A PHOTOGRAPHIC PRINTING PLATE

Filed May 26, 1930

Fig. 1

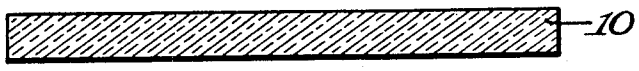


Fig. 2

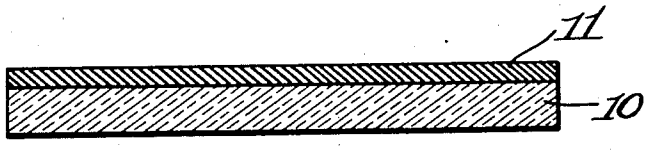


Fig. 3

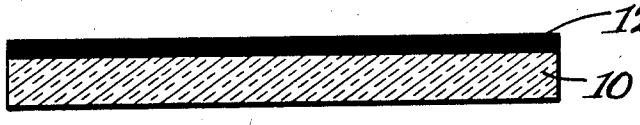


Fig. 4

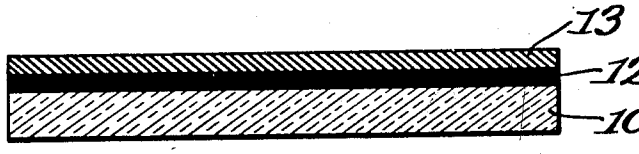


Fig. 5

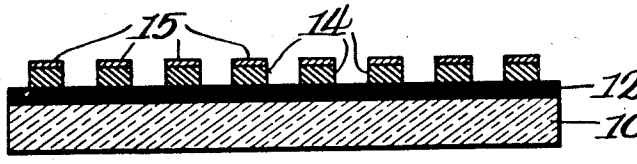


Fig. 6

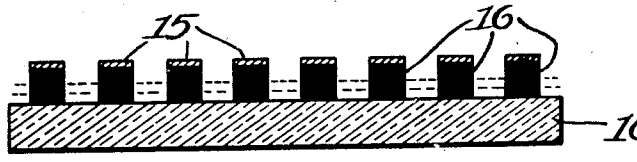


Fig. 7

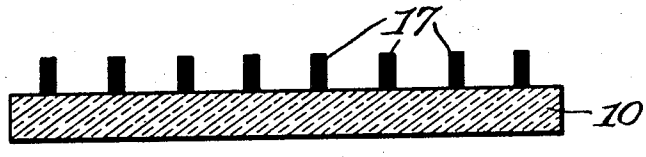


Fig. 8



Fig. 9



Fig. 10

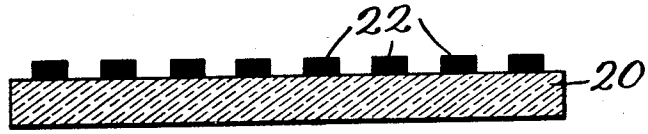
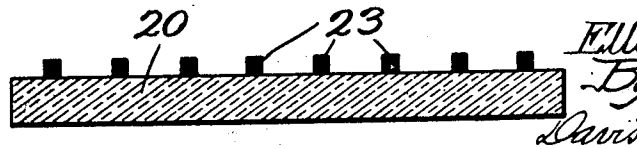


Fig. 11



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Patented May 8, 1934 1,957,433

UNITED STATES PATENT OFFICE

1,957,433

METHOD OF MAKING A PHOTOGRAPHIC PRINTING PLATE

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Application May 26, 1930, Serial No. 455,882

8 Claims. (Cl. 95—5.6)

This invention relates to improvements in photographic plates for use in the lithographic arts and its purpose is to provide an improved negative or positive printing plate produced by an improved method according to which the rendition of color and tone in the reproduced image more accurately follows the original copy than has been possible by any method heretofore known.

The increase in employment of offset lithography in the graphic arts has been more or less retarded in the past by inadequate and indirect methods of correcting the deficiencies of photographic images on printing plates insofar as the rendition of color and tone is concerned. Heretofore, two such methods have been employed, these being known as the staining method and the ground glass method. The older of these methods is the staining method by which the photographic image is stained with dye for the purpose of securing color and tone correction through the medium of light absorption. By this staining process, areas which appear too dark in the photographic image are rendered lighter in tone by the application of the dye solution, which is usually of the aniline class and reddish in color. The dye, when applied to the printing plate, causes more or less absorption of the transmitted light, thereby producing a decreased light action on the areas so treated and causing a consequential lightening of tones by reason of the decreased activity of the actinic rays of the transmitted radiations. The staining method has the disadvantage that it affords a very narrow latitude for the correction of tones and unless spectroscopic equipment is available, the average workman has no accurate idea of the relative proportions of light which are absorbed and transmitted. Even very slight errors in the color strength of the applied dye solution will promote decided alterations in the light-transmitting character of the dyed areas. This may bring about either overcorrection or undercorrection of the dyed areas which results in images which are false reproductions of the originals. This method therefore depends too much upon the skill of the individual workman and is difficult of execution even by the most skilled hands.

The second method, known as the ground glass method, is more widely used at the present time and consists in making the color and tone corrections by manually retouching the photographic image on the ground glass plate. By this method, correction is brought about by variation of the opacity of certain of the parts of the composite image, mainly by the application of graphite, crayons or air brushes to the required parts in the effort to increase the opacity of these regions, and so lightening the untreated areas by increasing the opacity of those parts which were rendered too dark or transparent in the original photographic negative. According to this method, the first step is to make continuous tone negatives of the original subject to be reproduced. From these negatives, continuous tone positives are made on the ground glass, one for each color or hue to be printed. The artist then retouches the positive images on these plates, according to the degree of error present in different parts of the images and the relative amount of color or strength the different parts of the image should possess in order to reproduce correctly the original. This manual retouching of the continuous tone positive results in considerable smearing or smudging of the subject and is incapable of bringing about a correct reproduction of the original in all of its detail.

Either of the foregoing prior art methods represents a radical departure from pure photographic principles. The intervention of materials such as crayons or graphite is certain to obliterate to a greater or lesser extent the photographic appearance of the reproduced image. It is impossible to secure effects similar to the reproductions of an original by methods of such a nature, as the artist is promoting corrections by individual manipulation of different parts of the image rather than through photographic corrections based on the laws of optics and chemistry. It is apparent from these considerations that the important object to be sought is the corrections of the photographic plate by treatment of the photographic image itself and not by such artificial methods as the dyeing or manual manipulation of the image.

The method of securing the desired correction by treatment of the photographic image itself may be most expeditiously performed by the process of systematic re-etchment of the photographic image itself whereby any desired area can be progressively lightened or darkened by reduction of the component elements of the image which are usually embodied in a geometric series of minute dots secured through the employment of a half-tone screen in the operation of photographing the image on the plate. Although processes of this kind have heretofore been employed in the photo-engraving industry, no such method has heretofore been employed in the manufacture or correction of photographic plates and the principal object of the present invention is to adapt such a method to the purposes of offset lithography so that printing plates may be made to reproduce accurately the original subject without introducing the inaccuracies which have been present in the methods heretofore employed. By means of the improved method of the present invention, the lithographer is enabled to secure at will any desired correction of the printing plate

by recourse to a process analogous to etching whereby the size of the printing dot in any area can be altered by a system of reduction according to which the relative sizes of the dots on different areas of the subject may be altered by chemical dissolution or reduction. According to the persent invention, the correction of the color and tone values of the different parts of the image is brought about by a process of etching photographic half-tone images on glass with a suitable mordant which progressively decreases the sizes of the half-tone dots or other elements wherever applied and in proper ratio to the degree of correction required. An important feature of the present invention is that the printing dots or elements which form the image on the glass plate are so metallized or coated during the process of forming the plate in preparation for the etching process that the mordant acts upon the dots or elements in reducing their size without decreasing their depth or projection from the surface of the glass plate and without causing the edges thereof to assume a fuzzy or irregular contour, so that the individual elements which make up the composite image are reproduced in sharp outline without any of the smearing or smudging effect which has been characteristic of the hand correction method. A further object of the present invention is that the printing plate may be manufactured and corrected quickly as compared with the time required for the making of corrected plates by previously known methods, thus resulting in a great saving in the cost of making the corrected plate in addition to making possible a more accurate reproduction of the subject. Other objects of the invention relate to various features of the improved plate and various details of the method which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawing in connection with which several embodiments of the improved method are explained. In the drawing,

Fig. 1 shows a vertical section through a horizontally positioned glass plate adapted for use in forming a printing plate by the method of the present invention;

Fig. 2 is a sectional view similar to that of Fig. 1 showing the condition of the ground glass plate after a coating of a sensitive emulsion has been applied thereto in the first step of one example of the improved process;

Fig. 3 is a sectional view similar to that of Fig. 1, showing the condition of the plate and its coating at the end of the second step of the process after the sensitive emulsion has been blackened;

Fig. 4 is a sectional view similar to that of Fig. 1 showing the condition of the plate at the end of the third stage of the process after an acid-resistant coating has been applied over the blackened emulsion;

Fig. 5 is a sectional view of the printing plate at the end of the next succeeding stage of the process after the plate has been exposed in contact with the negative under the action of light and after the subsequent operations of washing out the plate and inking the projecting dots or elements which form the image;

Fig. 6 is another sectional view of the printing plate after a subsequent stage of the process showing the unprotected portions of the blackened emulsion as having been etched away;

Fig. 7 is another sectional view showing the printing plate in the final stage of the process after the projecting dots or printing elements have been reduced in size by the action of the etching solution acting on the lateral sides thereof without decreasing their projection from the surface of the glass plate;

Fig. 8 is an enlarged sectional view through a ground glass plate adapted to form the base for a modified process of making the photographic printing plate by the process of the present invention;

Fig. 9 is an enlarged sectional view similar to that of Fig. 8, showing the glass plate after a sensitized emulsion has been applied thereto;

Fig. 10 is an enlarged sectional view similar to that of Fig. 9, showing the condition of the plate in a succeeding stage of the process after printing dots have been formed thereon by the exposure of the coating under a half-tone negative; and

Fig. 11 is a sectional view showing the plate illustrated in Fig. 10 when it has reached the final stage of the process wherein the areas of the dots have been reduced by the etching step of the process.

According to the practice of one example of my improved method, a ground glass plate 10, suitable for printing plate purposes, as shown in Fig. 1, is provided with a sensitive coating known as a gelatino-bromide emulsion which contains salts of metal such as silver and copper and which solution is preferably made up according to one or the other of the following Formulæ A or B, wherein the ingredients are combined in the proportions stated:

A

Water distilled	4 fluid ounces
Ammonium chloride	32 grains
Potasium bromide	40 grains
Citric acid	50 grains
Hard gelatine	3 fluid ounces

B

Distilled water	3 fluid ounces
Nitrate of silver	120 grains
Copper sulphate	120 grains

This sensitive coating 11 is shown in Fig. 2 on an enlarged scale for the sake of clearness, although it will be understood that in practice this and other coatings applied to the glass plate are comparatively thin. This coated plate as shown in Fig. 2 is then exposed to the action of light, without the interposition of a negative, and the exposed plate is then developed and fixed in the regular photographic manner with the result that the glass plate then bears an opaque or blackened metallic coating 12, as shown in Fig. 3. The next step of this form of the process consists in applying to the metallic coating 12 another coating 13 of acid-resisting material which may preferably be a solution of ammonium bichromate in a colloid such as albumin or fish glue, thus forming a protective layer for the metallic coating which resists the etching action upon the outer surfaces of certain portions of this layer in the subsequent etching process. This bichromated colloidal acid-resistant solution is preferably made up of the following ingredients combined in the following proportions:

Water	32 fluid ounces
Albumin	3 ounces, by weight
Bichromate of ammonium	¼ ounce, by weight

After applying the coating 13, the sensitivity of the plate is comparable to that of a very slow gelatino-chloride emulsion.

The next step of this form of the process consists in exposing the coated plate, shown in Fig. 4, to the action of light under a half-tone negative, the exposure being preferably with arc lamp illumination for a period of from one to ten minutes, according to the character of the negative and its subject. The exposed plate is then rolled up with an acid-resisting ink and this is followed by the washing of the plate in order to remove all portions of the chromium salts which have not been affected by the action of light, thus resulting in the production of a plate having the cross-sectional form shown in Fig. 5, where the projecting portions represent the dots formed by parts of the ink coated layer 13 which have been exposed to the action of light. These projecting parts 14 extend upwardly from the layer 12 formed by the blackened emulsion and the outer or upper ends of these projections 14 are covered by the individual ink coatings 15. The next step consists in drying the plate and then immersing it in a bath made up of the following ingredients combined in the following proportions:

Copper sulfate	¼ ounce, by weight
Potassium bromide	¼ ounce, by weight
Water	16 fluid ounces
Hydrochloric acid, C. P	20 minims

The plate is continued in this bath until all of the unexposed parts of the image have a milky hue and it is then removed and washed in cold water to remove all traces of the bath solution after which it is washed with a strong sodium thiosulphate solution which will completely remove the milky appearance in the unexposed regions. The plate then has the cross-sectional appearance shown in Fig. 6, wherein the portions of the blackened emulsion between the dots which have been protected by the acid-resistant coating have been washed away down to the glass plate, leaving the dots coated on their outer end surfaces by ink as shown at 16.

At the conclusion of the last described step of the process, the plate is dried and it is prepared for a dot reduction process by washing off the image with carbon tetrachloride or other solvent, thus leaving the dots having a depth of projection from the glass plate equal to the thickness of the coatings applied to the plate. These dots are completely metallized from the surface of the emulsion to the glass support so that they are capable of being reduced by a process of etching without a loss of density. The reduction of the dots is effected by a process of fine etching similar to that of photo-engraving except that it is carried on with a mixture of sodium cyanide and iodine as a mordant instead of the ferric chloride which is usually employed in photo-engraving. The coating of the plate with the etching solution and the etching of the metallized dots resulting therefrom may be repeated as many times as is necessary to achieve the desired results. Since the outer end surfaces of the dots are protected by the acid-resistant coating applied thereto, the etching takes place from the sides of the dots inwardly so that they finally assume the reduced proportions shown at 17 in Fig. 7. By this method, the dots may be caused to assume any desired degree of fineness without destroying the relatively flat character of the end surfaces thereof which do the work in the subsequent printing operation and the outer contour of each dot is comparatively smooth so that it is recorded in a sharp outline in the resulting printing operation without any irregular projections which might give a blurry effect in the final image. In the practice of this method, no fixation of the underlying emulsion 12 is necessary as the salts contained therein are removed in the subsequent process of etching through the action of the cyanide reducer or mordant.

As a modification of the method described above, the emulsion-coated plate may be placed in a solution of bichromated colloid and then dried preliminary to exposing it under a half-tone negative. The exposed plate is then washed to remove all soluble portions of the colloid and is then developed and fixed. After drying the plate at this stage, it is ready for the etching operation which constitutes the final step of the process first described.

Instead of using the bichromated colloid as the coating 15 of the plate, a light sensitive varnish or Syrian asphalt may be employed. In this case, the emulsion coating 12 serves as a substratum for a coating of the varnish or asphalt. The plate so prepared is then exposed under a positive after which the exposure is developed with a solution suitable for the type of sensitizer used.

Although the process hereinbefore described, and its modifications, have been found to give satisfactory results, the method now to be described is preferred for the commercial practice of the invention. According to this preferred method, a ground glass plate 20, as shown in Fig. 8, is provided with a coating 21 of the gelatino-bromide emulsion previously described, as shown in Fig. 9. This plate, with the blackening or emulsified coating 21, is then exposed under a half-tone negative for such a length of time as is considered necessary for the production of an impression of the image of the particular strength or graddation necessary for the correction of errors inherent in the original half-tone negative. The latent image thus produced on the plate is then developed in a special developer containing no alkali or any other form of accelerator. As one example of such a developer, one may use a solution consisting of the following ingredients combined in the following proportions:

Water	32 fluid ounces
Sodium sulphite	1 ounce, by weight
Amidol	75 grains
Potassium bromide (10% solution)	35 minims

It is desirable to avoid the presence of alkali in this solution in order that it may not have a tanning action on the developed image. The development in this solution is continued until all of the light affected salts are completely reduced to the metallic stage, thus forming an image possessing an opacity which is capable of permitting the subsequent correction or etching operation to be carried on without a loss of density in the constituent elements or dots of the half-tone positive. The plate then has the form shown by the section view of Fig. 10, where the dots constituting the image are shown at 22 projecting upwardly from the glass plate. After the development has been carried on to the required degree, the positive is washed with water under the tap and is then transferred to a plain fixing bath composed preferably of the following ingredients combined in the following proportions:

Sodium thiosulphate	2 pounds
Water	128 fluid ounces

The fixation of the image proceeds rapidly and

after the removal of all of the metallic salts which have not been affected by light, the positive is thoroughly washed with water to eliminate the thiosulphates which may be left on the coating or image after fixation.

By the preceding steps of the last described process, there is produced a half-tone positive which should faithfully record the tonal characteristics of the primary image and although this image could be etched or reduced within certain limits, without further treatment, it is preferably protected against the loss of density by submitting it to the action of another solution which may preferably consist of the following ingredients combined in the following proportions:

Copper sulfate	1 ounce, by weight
Potassium bromide	1 ounce, by weight
Potassium bichromate	75 grains
Glacial acetic acid	40 minims
Water	32 fluid ounces

In this bath, the positive image is slowly bleached a pale yellowish color and when it is fully bleached it is again washed with water to remove all traces of the compound employed in the bleaching bath.

After treating the plate in the bleaching bath and washing it, the bleached positive is converted to its original metallic state by immersing it in the developing solution employed for the initial production of the latent image and then exposing it to the action of light. After this treatment, the positive is dried and is then ready for etching. The etching is carried on by immersing the plate in a diluted solution of sodium cyanide and iodine, as in the practice of the method first described and the etching is allowed to continue until those areas of the plate requiring the least correction have been brought to their correct tonal strength. These parts are then covered with an impervious varnish which is insoluble to the mordant used. Various preparations may be employed for this purpose but asphaltum is now preferred. After these areas have been covered with asphaltum, the image is subjected to another etching operation in order to further reduce the sizes of the elements or dots in other areas of the plate to the tonal depth and strength required. In each step of the etching operation, the action of the etching solution is to cause dissolution of the edges of the half-tone dots and as the etching continues, the relative area of each individual dot or element progressively decreases, as shown at 23 in Fig. 11. Inasmuch as the central portion of the dot is harder than the outer portions and since the outer end surface is smooth and hard as compared with the relatively rough or irregular condition of the edges of the dots, it has been discovered that the etching solution acts only on the edges of the dots so that the dots or elements are decreased in size from their edges inwardly without decreasing the projection of the dots from the surface of the plate, so that a final result is obtained which is similar to that obtained by the first described method of this invention except that this method is more direct. By subjecting different parts of the image to different numbers of etching operations, any desired degree of contrast may be obtained between different parts of the image, and the resulting printing dots, although varying in size in different parts of the image, are sharp in outline and produce the desired accurate result in the printed work. The etching step of the process, although somewhat similar to the etching employed in photo-engraving, is carried out on a glass positive instead of on metal plates.

When the etcher is satisfied that the positive plate accurately portrays the original subject, the positive image is printed therefrom onto another glass plate using the same emulsion as was employed for the formation of the positive image. The latent image thus produced on the second glass plate is negative in character and is developed and fixed in the same manner as the image on the positive plate was developed and fixed. This negative image is a reversed duplicate of the etched image and forms the negative which may be used for printing on the sensitized zinc plate to be used in the lithographic art for reproducing the subject in multiple copies. As many negative plates as may be desired may be reproduced from the etched positive plate which remains as a master plate from which future orders may be filled. If the etched positive becomes damaged, it is only necessary to make another print from the original negative and again proceed to form a corrected positive plate which is much simpler than in processes heretofore employed where attempts have been made to make corrections on the original negative.

By means of the method of the present invention, a correct positive plate is produced by making the corrections along photo-mechanical lines, depending entirely upon the proven action of physio-chemistry and accomplishing all corrections within the sphere of photography, without depending upon the inaccurate method of staining and without incurring the danger of obliterating portions of the image or its elements, which is inherent in the manual retouching of images. The lithographer can determine at a glance the degree of correction obtained merely by study of the appearance and dot formation of the image which gives an accurate gauge of the tone and color quality of each portion of the image so that the lithographer can determine, in advance of any printing operations, the exact character of the printed impression which will be formed by these microscopic elements or dots. The experienced etcher knows the color or strength produced by a certain size of dot and is therefore enabled to base his judgment upon the firm foundation of photo-mechanics rather than upon the insecure foundation arising from a matter of judgment of light transmittance and absorption. No set rules can be prescribed for the extent or number of repetitions of the etching step and this will depend upon the judgment of the etcher, who will determine when the different portions of the image have reached the desired stage of reduction, as indicated by the size of the dots and the relative proportions of the dots in different parts of the image.

The method of this invention has marked advantages over the ground glass method of correction in the practice of which the artist has no definitely accurate idea of the relative proportion of light transmitted by the different retouched portions of the plate and if his judgment is faulty in this respect, discovery or the error can only be made after the final negatives have been taken therefrom and after the zinc plates printed from the negatives have been proved.

Although certain examples of the improved printing plate and certain illustrations of the improved method have been set forth herein, it

will be understood that plates embodying the present invention may have various characteristics and may be made by various methods within the scope of the appended claims.

I claim:

1. The method of forming a photographic printing plate which consists in coating a transparent plate with a sensitized emulsion containing metallic salts, exposing said coating to the action of light under a half-tone negative, developing said plate until all of the light affected salts are completely reduced to the metallic state, then washing the developed plate, then treating said plate with a deep bleaching solution, then converting the image on said plate to its original metallic state by treating it with a developing solution and exposing it to the action of light, and then chemically etching the resulting image carried by said plate.

2. The method of forming a photographic printing plate which consists in coating a transparent plate with a light sensitive gelatino-bromide emulsion containing salts of silver and copper, exposing said coated plate to the action of light under a half-tone negative, then developing said plate with a developing solution free of any accelerator, then washing said plate in a fixing solution, treating the plate with a bleaching solution, converting the resulting image on the plate to its original metallic state, treating it with a developing solution and exposing it to the action of light, and then drying and etching said plate.

3. The method of forming a photographic printing plate which consists in coating a transparent plate with a light sensitive solution, exposing said coating to the action of light under a half-tone negative, developing the exposed plate in a developing solution free of alkali until all light affected salts are completely reduced to the metallic state, then washing said plate with a fixing solution, subjecting said plate to the action of a bleaching solution containing salts of copper and potassium, then converting the image on said plate to its original metallic state by treating it with a developing solution and exposing it to the action of light, and then chemically etching the image carried by said plate.

4. The method of forming a photographic printing plate which consists in coating a transparent plate with a light sensitive solution, exposing the coating to the action of light under a half-tone negative, developing the image so produced on the plate, washing said plate with a fixing solution, then subjecting said plate to the action of a bleaching solution containing copper sulphate, potassium bromide, potassium bichromate and acetic acid, then washing said plate and converting the image to its original positive state by immersing it in a developing solution and exposing it to the action of light, and then drying said plate and etching the image thereon by chemical action upon the individual elements of the image.

5. The method of forming a photographic printing plate which consists in coating a transparent plate with a light sensitive solution, exposing the coating to the action of light under a half-tone negative, developing the image so produced on the plate, washing said plate with a fixing solution, then subjecting said plate to the action of a bleaching solution containing copper sulphate, potassium bromide, potassium bichromate and acetic acid, then washing said plate and converting the image to its original positive state by immersing it in a developing solution and exposing it to the action of light, and then etching the plate by immersing it in an etching solution containing sodium cyanide and iodine.

6. The method of forming a photographic printing plate which consists in coating a transparent plate with a light sensitive solution, exposing the coating to the action of light under a half-tone negative developing the image so produced on the plate, washing said plate with a fixing solution, then subjecting said plate to the action of a bleaching solution containing copper sulphate, potassium bromide, potassium bichromate and acetic acid, then washing said plate and converting the image to its original positive state by immersing it in a developing solution and exposing it to the action of light, then etching the plate by immersing it in an etching solution containing sodium cyanide and iodine, then coating portions of the image with a substance which is insoluble in said etching solution, and then repeating the etching of those portions of the image which have not been covered by said insoluble coating.

7. The method of forming a photographic printing plate which consists in coating a transparent plate with a light sensitive emulsion containing salts of silver and copper, then exposing said entire coating to the action of light and fixing the blackened metallic coating thus formed, then applying to said metallic coating an acid resisting solution containing ammonium bichromate, then exposing the coated plate to the action of light under a half-tone negative, then rolling up the image on the plate with acid resisting ink, then washing the plate to remove the portions of said bichromate solution not affected by the action of light, then drying said plate and immersing it in a bath containing copper sulphate and potassium bromide until all parts of the plate are of a milky hue, then washing said plate to remove the milky appearance in the unexposed portions, then drying said plate and washing it in a fixing solution, and then etching said plate.

8. The method of forming a photographic printing plate which consists in coating a transparent plate with a light sensitive emulsion containing salts of silver and copper, then exposing said entire coating to the action of light and fixing the blackened metallic coating thus formed, then applying to said metallic coating an acid resisting solution containing ammonium bichromate, then exposing the coated plate to the action of light under a half-tone negative, then rolling up the image on the plate with acid resisting ink, then washing the plate to remove the portions of said bichromate solution not affected by the action of light, then drying said plate and immersing it in a bath containing copper sulphate and potassium bromide until all parts of the plate are of a milky hue, then washing said plate to remove the milky appearance in the unexposed portions, then drying said plate and washing it in a fixing solution, and then etching said plate in a solution containing sodium cyanide and iodine whereby the individual dots of the image are reduced from their edges inwardly while substantially maintaining their projection from the surface of said transparent plate.

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