A. VALENTIN & J. ZERREISS.

METHOD OF PRODUCING PRINTING PLATES.

APPLICATION FILED AUG. 16, 1909.

1,012,762. Patented Dec. 26, 1911.

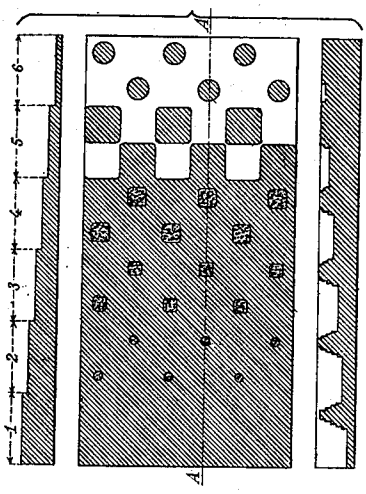

Fig. 13.

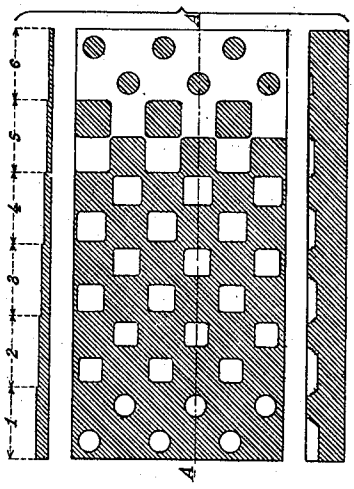

Fig. 14.

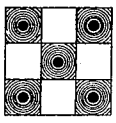

Fig. 4.

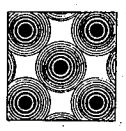

Fig. 7.

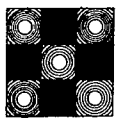

Fig. 3.

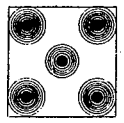

Fig. 6.

Fig. 2.

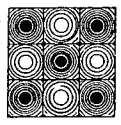

Fig. 5.

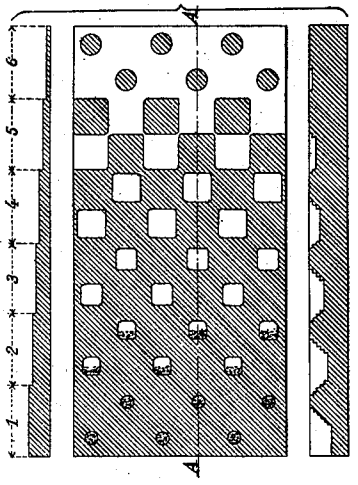

Fig. 12.

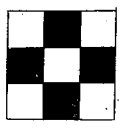

Fig. 1.

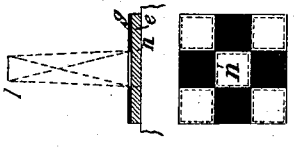

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

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UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING PRINTING-PLATES.

1,012,762. Specification of Letters Patent. Patented Dec. 26, 1911.

Application filed August 16, 1909. Serial No. 513,072.

To all whom it may concern:

Be it known that we, AUGUSTE VALENTIN, a citizen of the Republic of France, residing at Puteaux, Seine, France, and JEAN ZERREISS, a subject of the German Empire, residing at Courbevoie, Seine, France, have invented certain new and useful Improvements in Methods of Producing Printing-Plates, of which the following is a specification.

This invention relates to improvements in or relating to the production of printing plates.

In the accompanying drawings Figures 1 to 9 illustrate the production of screens and Figs. 10 to 14 illustrate the manner in which a printing plate is etched.

The process hereinafter described makes it possible to obtain direct on metal: 1. Plates engraved in intaglio from positive photographic line or half-tone originals. These plates engraved in intaglio, reproduce, without any touching up, all the fine tones and all the half-tones of the positive original print. All the tones are constituted by hollows the dimensions of which, as regards extension and depth, are in exact proportion to the different intensities of tones. It is a process which from the point of view of quality, has a double efficiency. An efficiency produced by an extension of the hollows in proportion to the intensity of the tones, and an efficiency produced by the thickness of ink retained in the hollows, the depth of which is in proportion to the intensity of the tones. The inking of the plates obtained by this process, can be effected simply by the use of an inking and wiping system which enables the ink required for the printing to be regulated accurately and uniformly distributed. Plates engraved in relief for typographic printing from negative photographic line or half-tone originals.

General description of the process for obtaining plates engraved in intaglio.—A thin copper plate, well planed and polished on one of its surfaces, is prepared, and on the whole surface of the said plate is spread a layer of the following solution: water 500 gr., bichromate of ammonia 12 gr., sugar 8 gr., gum arabic 110 gr., ammonia 9.9 drops. The plate covered with that solution is secured to a revolving support which is first operated slowly and which is manipulated above a gas heating stove giving off a gentle heat which assists the drying. As soon as it is dried and cooled, the plate thus prepared is ready for being provided with a screen. The screen is produced on the whole surface of the plate photographically, by using as the original a net-work arranged in a peculiar manner, as will be hereinafter described, and having one of the shapes shown in Figs. 4, 6 and 7 according to the nature of the positive original to be engraved. The proceeding for the purpose is as follows: The glass (or film) provided with a screen, is placed on the glass of a screw printing press, with the face provided with the screen, inward. The copper plate prepared as already stated, is placed in contact with the screen. A thorough contact between the screen and the plate is insured by the screws of the printing frame, which are tightened as much as possible. The whole is exposed to the action of the sun, and when the action is considered sufficient, the development is effected under water from a tap. The plate suitably developed, will have on the whole of its surface the image of the screen constituted by a series of elements produced by the bichromate solution having been rendered insoluble everywhere where the light acted, that is to say, under the transparent elements of the screen. These elements are equal to each other, and their geometrical centers are at the same distance from each other. As will be seen farther on, the degree of exposure must be calculated so as to give to the elements of the layer, a sufficient resistance to the action of a mordant during a certain time. They must afterward crack when the action of the mordant continues beyond that time. As soon as the metal plate provided with the screen is developed, it is covered with the following solution: water 360 gr., beer 100 gr., bi-chromate of potash 15 gr., citrate of iron 1.3 gr., sugar 4 gr., albumen 120 gr., glycerin 2 gr., nitrate of silver 5 gr. The above must be mixed and 125 gr. of fish glue added to it.

The above solution is kept at a temperature of about 17° C. It is spread on the whole surface of the plate on the revolving support, and as soon as it is dry, it is ready to receive the photographic image to be engraved. The image is reproduced photographically in the printing frame. The prepared surface of the plate is placed into

contact with the positive original. After a sufficient exposure, the plate is varnished on the back, and is ready to be engraved. To that end, it is placed into a mordant vat containing a solution of perchlorid of iron of 45° B., in a quantity sufficient for covering the whole surface. The perchlorid will pass at first through the second layer, at the portions which have been little exposed, that is to say, at the portions corresponding to the shades. It will attack the bare portions of the metal which will be hollowed out, a kind of cup being formed. The corrosive action continuing, the walls of the said cup will be corroded, and the elements of the screen of the first layer reduced. The perchlorid will pass afterward through the tones of an intensity immediately below the strong shades, and successively through all the tones in proportion to their degree of exposure. The action of the mordant will be stopped by washing with water as soon as it begins to attack the strong lights of the subject. At that moment, the portions corresponding to the shades, will be constituted by the elements of the screen reduced by corrosion to the state of granulated points owing to the cracking of the first layer (produced by the long action of the mordant), and separated by deep hollows or recesses, while the portions corresponding to the lights, will be formed by the elements of the screen separated by slight hollows of small extent. The action of the mordant produces a black oxidation of the metal, which enables the engraving operation to be followed. The image will appear in black proportionately as the perchlorid passing through the second layer attacks the metal. The corrosion or etching having been completed, the plate, cleaned with potash, is ready to be inked and printed.

For obtaining plates engraved in relief, for typographic printing, the process is the same as just described for making printing plates engraved in intaglio, but in that case negative originals are used. On the other hand, the cracking of the elements of the screen during the etching must be delayed and become apparent only in the strongest lights of the subject. This delay of the cracking of the first layer can be brought about by an increase of strength of the elements produced on the first layer. This additional strength is obtained by a longer exposure of the screen and by a weak burning of the first developed layer.

Mechanical examination of the process.—As will be readily understood from the explanations of the foregoing general description, the shape of the screen and the nature of the layer constituting the same, play an important part as regards the final result. The constitution of the second layer required for forming the image, being so to say invariably fixed in accordance with a formula which gives the best results as regards strength and uniform permeability, only very small variations in the results could be obtained in practice. The researches of the applicants were chiefly directed, with regard to the said second layer, to the chemical composition of the sensitive solution by means of which it is possible to obtain, practically and in a thoroughly industrial manner, engravings which can be compared in every respect to those produced by the layer of bi-chromated gelatin used in heliographic processes. The modification of the final result in accordance with the nature of the subjects and the nature of the negative or positive originals employed, can therefore, be generally produced only by the modification of the shape of the screen, of the nature of the screen layer and the density of the mordant used for engraving. These various elements will be examined and in conclusion the result of their variations in the different cases of their use will be given.

Preparation of screens.—A very good glass, without any grooves and perfectly flat, is taken and prepared in accordance with the methods usually employed in the wet collodion or any other similar process. The glass thus prepared and rendered sensitive, is arranged as usual in the frame of a photographic apparatus provided with a screen-holder into which is placed a screen with check pattern, similar in every way to those employed in the mechanical engraving processes. The whole is placed in the apparatus in accordance with the methods generally used in photo-engraving, so as to produce, by exposure and on the development, on the whole of the surface of the sensitive glass a check pattern of the shape shown in Fig. 1, that is to say, formed by squares rendered absolutely opaque by an energetic intensification. These points are in contact with each other at the corners and are very sharply defined at the side of the transparent squares which separate them. The glass is covered with rubber, then again covered with collodion and rendered sensitive. It is then replaced in the frame exactly at the point where it was at the first exposure in the chamber. Exposure is again made by suitably arranging the screen and using for the exposure a larger opening in the lens diaphragm than was used for the first exposure thereby producing slightly on the whole surface newly rendered sensitive, shaded off or "degraded" points of the shape indicated in Fig. 2. The glass being during the second exposure exactly at the same place as it was during the first exposure and it being of course understood that the screen is also located precisely at the same place during the second exposure, the

said degradation or shading off will be effected at the transparent portions of the first screen, and completed at the center of the same portions in a point rendered transparent by a suitable reduction. The screen, obtained by the combination of the two superposed images produced by the two layers differently exposed, as just described, will have the appearance shown in Fig. 3. The final screen required for the following operations, will be obtained by producing from the screen thus made, a photographic counter-type which at the development will present successively transparent, shaded-off or degraded and opaque elements shown in Fig. 4.

Possible modifications of the nature of screens for their use in the different practical cases.—In the foregoing examination of the preparation of screens, the simplest method of proceeding for obtaining normal screens, that is to say, screens which are adapted to the conditions most frequently occurring in practice, has been given. In certain cases where it is desired to have a high degree of fineness, as well as a complete reproduction of half-tones, it will be advisable to make other types of screens which, being more complete than those first described, will make it possible to produce on the first layer of the metal plate, a greater sensitiveness to the action of the mordant. Thus the screen previously described is again covered with a solution of rubber rendered sensitive, and exposed as before, replacing the round opening in the diaphragm by a square opening so as to obtain square points on the third sensitive layer of the plate, after a suitable exposure and development; the geometrical centers of the square points will coincide with the geometric centers of the round points formed on the first and on the second layer, and the screen will appear with three series of points of different intensity and of different shape uniformly superposed on each other on the whole surface of the plate.

For making a screen of the form shown in Fig. 5, a glass is prepared in the usual manner with moist collodion or any other sensitive emulsion, and the glass thus sensitized is placed in the frame of the photograhpic apparatus, the network screen being arranged in front of the glass at a suitable distance, whereupon a round diaphragm with a small opening is placed into the object glass, and on the pattern plate of the apparatus is placed a strongly lighted white paper. The sensitized plate is exposed by uncovering the object glass for about 2 minutes, the glass thus exposed is developed, and there will appear on the whole surface round opaque points. The developed glass is fixed, washed and dried then after having been covered with a weak solution of rubber is again covered with collodion and sensitized, then replaced into the frame of the photographic apparatus in order to be again exposed behind the network screen (care being taken to move it a little farther away than during the first exposure), a round diaphragm with a larger opening being used. After a suitable exposure, there will appear, after the development, on the whole surface of the glass round points superposed over the first one and of a larger surface, and a network screen will thus be produced, provided on the whole of its surface with fine opaque round points or dots arranged in the center of other round points more widely dispersed and more transparent, that is to say a screen with two gradations. This screen having been produced thus the plate is again covered with a solution of rubber, with collodion and sensitized, then exposed in the chamber behind the network screen arranged as before, a square diaphragm being used for this exposure in order, after the development, to produce, on the whole surface of the plate, square points touching each other with their corners, and the operation is continued, the sensitive layers being superposed and secured to each other by the weak solution of rubber. The said layers show successively as above described: The first, fine opaque round points obtained by using a round diaphragm with a small opening. The second, round points more widely dispersed and less opaque than the first ones, and obtained by using a round diaphragm with a larger opening. The third, square points touching each other with their corners and less opaque than the preceding ones, obtained by using a square diaphragm. The fourth, square points touching each other well at their corners, and leaving between them transparent square points with rounded off corners, and obtained by using a square diaphragm with recessed corners. The fifth, points, the angles of which penetrate decidedly into each other, and which leave between them round transparent points, this form of dots being obtained by the use of a square diaphragm the angles of which are recessed considerably. The superposition of these different forms of screens on one and the same glass, will form the screen shown in Fig. 5.

As is well known, the points produced on a sensitized glass through a net work screen, vary in shape and in distance from each other according to the shape of the diaphragm used, and the distance of the network from the sensitive glass; it will thus be understood that it will be easy to vary to an infinite extent the forms of network screens, superposed in the manner described on one and the same glass. On the other hand, it is possible to give to each of the superposed sensitized layers, different de-

grees of opacity by reducing the intensity after the development by means of a solution of cyanid of iodin. Thus for the screens shown in Figs. 6 and 7 round diaphragms will be used, the openings of said diaphragms increasing with each of the sensitive layers placed on the same glass, the said layers being suitably treated after the development to produce finally a gradation of intensity of the different forms of points that will have been superposed.

It will be evident that the screens can be constructed so as to give a larger area to the transparent elements as shown in Fig. 6, or on the contrary, so as to give a larger area to the opaque elements, as shown in Fig. 7. These different screens will be used in accordance with the nature of the originals, as will be described in the article relating to the special conditions determining the use of the different shapes of screens.

Formation of screen on the first layer.—As will be seen, the screen is constituted by the following entirely opposite elements: 1. Square elements distinctly transparent, and 2. Elements opaque at their geometrical centers, the opacity decreasing from the centers to the circumference. When a screen is produced on the first layer by the exposure of the screen, there will be produced on the whole surface of the plate a positive image of the screen, that is to say, there will be formed on the said surface square elements distinctly opaque and square elements transparent at their geometrical centers and decreasing in transparency from their center to their circumference; the said decrease being however only slight, so that finally there will be a great difference between the opaque squares and the adjoining ones. It is necessary to take another factor into account, in the formation of the screen, to wit:—the opposition between the transparent squares and the opaque squares of the screen being very great, the limit marking the difference of exposure, will follow distinctly a line only provided that the thickness of the sensitive layer is zero. But in reality that is not the case, and there will be formed a well known irridiation phenomenon (Figs. 8 and 9).

In Fig. 8, *g* is the screen, *e* the thickness of the first layer and *l* the source of light. Fig. 9 is plan of Fig. 8. A slight additional exposure, outside the periphery of the opaque square will reinforce the square on the whole of its circumference following the outline *n*, and the plate will show after the development and drying, a screen layer which will have different degrees of exposure which will be equally repeated on the whole of its surface, at each geometrical center of the points which divide it up. A copper plate provided with a screen, will, therefore, be formed, which will present, if submitted to the action of a mordant, a very great sensitiveness and will be capable of undergoing that action with a very special precision. This sensitiveness can be graphically illustrated by Figs. 10 and 11.

In Fig. 10, *e* represents the first layer, the different thicknesses of *e* represent the different degrees of exposure. The dotted lines indicate the action of the etching in accordance with the different degrees of exposure.

Fig. 11 is a plan of Fig. 10, which shows the different degrees of resistance to the action of the acid, due to the different degrees of exposure. Thus, the portion M will offer the maximum resistance for a certain time, after which it will crack. The portion N will have a resistance between the resistances M and P. The portion P will have a resistance decreasing from N to Q. The portion Q will have no resistance and will be attacked as soon as the mordant has passed through the second layer. If, on the other hand, the distance R separating the geometrical centers of the resisting points of the layer, is varied by the use of different sizes of screen, it will be seen that if R increases, the scale of existing sensitiveness between two adjoining geometrical centers spreads and reduces the number of portions sensitive to the action of the mordant; while, on the contrary, if R decreases, the number of sensitive portions increases. At the limit, that is to say, when R becomes infinitely small, there will be obtained on the metal plate a layer having such a constitution that each of its points will present a complete sensitiveness to all the tones, and the action of the mordant, regulated by the sensitiveness of the said layer, will produce on the metal plate an engraving which will reproduce, by its different recesses, all the fine-tones and all the half-tones of the subject.

Preparation of the second layer.—As soon as the plate provided with a screen, has been developed and dried, it is covered with the second layer which is put on on the revolving support. As soon as it is dried, it is exposed under the positive print or original of the image to be engraved, and after a suitable exposure which varies in accordance with the subjects, it is ready to be engraved.

Engraving.—For the constitution of the first layer practice has shown the use of (1) a screen of the shape shown in Fig. 4; (2) a solution of the following formula: water 500 gr., bichromate of ammonia 12 gr., gum arabic 110, sugar 8 gr., and ammonia 9.9 drops, to be suitable. In these conditions, the etching is effected normally by the use of a solution of perchlorid of iron of 45° B. in the following manner:

For facilitating the explanation it will be assumed that the print or original to be engraved, consists of six different tones represented by the diagram of Fig. 12, the different thicknesses of which represent the intensities of the tones, that is to say, the portion 6 represents the transparent portions of the original (the lights) the portions 5, 4, 3, 2 the tones of increasing intensity up to the portion 1 which represents the opaque portions. The perchlorid will pass first through the portions of the second layer which have been exposed the least, that is to say, the portions 1 corresponding to the deep shades and will attack the metal everywhere where it is exposed, that is to say, in the center *o* of the points *q*, *r*, *s*, *t* (Fig. 11) which will be hollowed out and will spread as the etching is continued. The perchlorid will then pass successively through the portions 2, 3, 4, 5 and 6 and will successively hollow out the centers of the points of bare metal, corresponding to the said tones. At the moment when the portions corresponding to the tone 6 will be only attacked at the centers of the points corresponding to the said tones, the hollows corresponding to the tone 5, will have spread until *u* (Fig. 11), the hollows corresponding to the tone 4 will have spread to *v*. The action of etching will continue to spread toward the periphery, and the hollow will assume the shape indicated by *v*. The etching continuing, the angles *q*, *r*, *s*, *t* of the resisting points of the layer, will intersect each other, and the hollows corresponding to the tone 3, will spread to *y*. The hollows corresponding to the tone 2, will spread out to *x*, the hollows corresponding to the tone 1 will be very widely spread and will leave between them only a weak point. Moreover, the etching in these portions having been prolonged, the first layer will crack, and the perchlorid, passing through the said layer, will granulate the surface of the points, and the finished plate will have the appearance shown in Fig. 12.

Special conditions determining the use of the different shapes of screens, the nature of the first layer and the density of the mordant to be used.—Photographic prints required for producing engraved plates generally have different characteristics as regards their photographic qualities. The said different qualities will be defined with reference to three types of originals or prints defined in the following manner:

1st type. The difference of intensity between the lights and the shades is normal, that is to say, the lights are transparent, and the shades strong without opacity. The details are well defined. The original or print is good.

2nd type. The difference of intensity between the lights and shades is slight, that is to say, the lights are not absolutely transparent, and the shades not very strong, the details being defined. The print is gray.

3rd type. The difference of intensity between the lights and the shades is strong, that is to say, the pure lights are transparent, the shades are opaque and the details are generally faintly drawn. The print is hard.

In order to determine the variations to which must be subjected each of the three elements which can be usefully modified (shape of the screen, kind of the first layer, density of the mordant) in the different practical cases, let us examine first what will happen when the nature of the said three elements is normal, that is to say, such as it ought to be for obtaining a good result when a print of the first type is used. In that case experience has shown that: the screen must be of the shape shown in Fig. 4; the first layer is given by the following formula: water 500 gr., bichromate of ammonia 12 gr., gum arabic 110 gr., sugar 8 gr., and ammonia 9.9 drops; the density of the mordant (liquid perchlorid of iron) 40° B. These elements having thus been experimentally determined, let the result of using them with the three types of print described be considered. Assuming that for the purpose three copper plates are provided with a screen of the shape shown in Fig. 4, with a first layer of the normal formula, and all three comprising a second sensitive layer of the same formula.

Figs. 12–14 show the action of the etching on the three copper plates provided in the manner described with a screen of the form shown in Fig. 4. These three plates comprise layers of the same kind, but they are exposed each under a different positive. Fig. 12 shows the action of etching on one of the said plates exposed under a positive which is good (first type). Fig. 14 shows the action of etching on one of the said plates exposed under a gray positive (second type). Fig. 13 shows the action of etching on one of the said plates exposed under a "hard" positive (third type).

Figs. 12–14 comprise each three views connected by a brace. The upper views represent the tones of the positive, the different intensities of which are represented by the different thicknesses. The portions 1 represent the shades, and the portions 6 the lights. The center views are views in plan of the engraved plates, the surfaces of the hollows being shown by black portions. The bottom views are sections on the line A—A of the engraved plates. They indicate the depth of the hollows corresponding to each of the tones and the gradation of the etching. Let the first of these plates (Fig. 12) be exposed under a positive of the first type, that is to say, under a very good positive; the second un-

der a positive of the second type (Fig. 14) and the third under a positive of the third type (Fig. 13). Let the etching be done then in a perchlorid of 40° B. By dividing up the action of the etching into three stages (first stage: etching the shades; second stage: etching half-tones; third stage: etching the lights), it will be seen that in the first stage: the plate exposed under the hard positive will be first attacked in the shade portion. The plate exposed under the good original will be the second to be attacked in the shade portion. The plate exposed under the gray original or print, will be the third to be attacked in the shade portions. In the second stage: the plate exposed under the gray original or print will be the first to be attacked in the half-tones. The plate exposed under the good original will be the second to be attacked in the half tones. The plate exposed under the hard print or original, will be the third to be attacked in the half-tones. In the third stage: the plate exposed under the gray original or print will be the first to be attacked in the light portion. The plate exposed under the good original or print will be the second to be attacked in the light portions. The plate exposed under the hard original or print will be the third to be attacked in the light portions. In short, the plate exposed under the gray original print will be the last to be attacked and the first to be finished. The action of the mordant is, therefore, exercised for a very short time; the shades will not have had time to be sufficiently hollowed out, and the points will not be sufficiently reduced. On the other hand, the cracking of the first layer will not take place, so that, on being inked in, the plate will have a regular or uniform appearance. In order to increase the effect, it would have been necessary that at the shades the points should have been more "reduced," that is to say, that the said points should have been at the beginning of the etching smaller and less resisting. This would have been insured by the use of a screen of the shape shown in Fig. 7, and by the use for the first layer of a solution of smaller resistance. On the other hand, it is well known that, when the density of the perchlorid is great, it passes with greater difficulty through the second layer, and passes through it only in the shade portions and up to a certain degree of exposure. It will, therefore, be possible to utilize this property which, by the use of a perchlorid of suitable density will enable the shades to be hollowed out before attacking the half-tones and a sufficient hollow and reduction of the points to be obtained. When the said result is reached in the shade portion, the etching will be continued by substituting for the perchlorid of high density, a perchlorid of smaller density which will pass through the half-tones and hollow out the metal at the same time reducing the points. As regards the lights, the density of the perchlorid will be still further decreased, and a plate engraved by gradation will be produced, which gradation will increase the effect by doing away with the uniformity of the etching. For facilitating the cracking of the first layer in the shade portion, a solution of smaller resistance will be used for forming the said layer. Similar considerations deduced from the preceding observations, would lead to show that when a hard print is used, it is necessary to use for forming the first layer a screen of the form shown in Fig. 6 and a solution of a greater resistance, and the different elements constituting the first layer and the densities of the mordants to be used for each of the three types of prints previously described, could be defined as follows:

Normal original or print.—First layer: Screen of the shape shown in Fig. 4 (transparent elements equal to opaque elements). Solution of the following formula: 500 gr. of water, 12 gr. of bichromate of ammonia, 100 gr. of gum arabic, 6 gr. of sugar and 9.9 drops of ammonia. Etching. First stage: solution of perchlorid of iron of 40° B. Second stage: solution of perchlorid of iron of 38° B. Third stage: solution of perchlorid of iron of 35° B.

Gray original or print.—First layer: Screen of the shape shown in Fig. 7 (transparent elements smaller than the opaque elements). Solution of the following formula: 500 gr. of water, 12 gr. of bichromate of ammonia, 110 gr. of gum arabic, 8 gr. of sugar, and 9.9 drops of ammonia. Etching. First stage: solution of perchlorid of iron of 45° B. Second stage: solution of perchlorid of iron of 40° B. Third stage: solution of perchlorid of iron of 38° B.

Hard original or print.—First layer: A screen of the form shown in Fig. 6 (transparent elements larger than the opaque elements). Solution of the following formula: water 500 gr., bichromate of ammonia 12 gr., gum arabic 135 gr., sugar 10 gr., and ammonia 9.9 drops. Etching. First stage: solution of perchlorid of iron of 38° B. Second stage: solution of perchlorid of iron of 36° B. Third stage: solution of perchlorid of iron of 34° B.

General applications of the process.—It is possible by means of this process to produce engraving plates for printing in several colors, whether the original single color prints have been obtained by any of the reproduction processes at present used, or whether they have been obtained by the processes of photographic selection from nature

or from originals in colors. It is, however, necessary to distinguish more particularly one of the most important applications which makes it possible to produce from photographic color originals or prints obtained from nature by the Lumiere processes (orthochromatic plates) or by the processes of Ducos du Hauron, engraving plates by means of which it will be possible to print in three colors a polychromatic positive. In other words, it will be possible to obtain with a single polychromatic original or print, three single-color printing plates (yellow, red and blue) engraved direct in intaglio, which on being printed by the present process and registered on one and the same vehicle (paper, fabrics, etc.,) will reproduce all the colors of the positive original or print used. For obtaining this result, it will be necessary to prepare three copper plates which will be provided with an identical screen in the manner described, on a first layer of the same formula. The first of these plates will be covered with a second layer orthochromatized for the yellow. The second of these plates will be covered with a second layer orthochromatized for the red. The third of the said plates will be covered with a second layer orthochromatized for the blue. The first plate will be exposed under the original polychromatic print by arranging a violet screen on the glass of the printing frame. The second plate will be exposed under the original polychromatic print by arranging on the glass of the printing frame a green screen. The third plate will be exposed under the original polychromatic print by arranging on the glass of the printing frame an orange screen. In that way, on the plates being exposed, the second layer on each of the said plates will be rendered insoluble, in proportion to the intensity of the yellow, red and blue radiations, and on engraving there will be obtained on the first plate single color reproduction in yellow, on the second ditto in red and on the third plate ditto in blue. The superposed impressions of the said three engraved plates (yellow, red and blue) will reproduce without any touching up, the exact image of the color print or original used. In this kind of engraving and color printing the same perfection will be obtained as in engraving and printing in black. It will also be possible to obtain from single-color or polychromatic originals black or color printing plates of a subject in any size by applying the method of photographic projection to the present process.

We claim:—

1. The method of producing printing plates, which consists in covering the metal plate with a sensitive layer, then exposing the same under a screen so as to produce on the whole surface of the plate square elements distinctly opaque and elements transparent at their geometrical centers which elements decrease in transparency from the center to the circumference, then developing the said plate, covering the plate with a sensitive layer, allowing the said layer to dry so that it forms a film, then producing on said layer the image to be engraved by means of an exposure through an ordinary photographic original or print, and then subjecting the plate thus exposed to the action of a mordant.

2. The method of producing printing plates, which consists in covering the metal plate with a sensitive layer, exposing the same under a screen so as to produce on the whole surface of the plate square elements distinctly opaque and elements transparent at their geometrical centers which elements decrease in transparency from the center to the circumference, then developing the said plate, covering the plate with a sensitive layer, allowing the said layer to dry so that it forms a film, then producing on said layer the image to be engraved by means of an exposure through an ordinary photographic original or print, and then subjecting the plate thus exposed to the action of a mordant consisting of perchlorid of iron having a density varying between 34 and 45 degrees B. according to the intensity of the photographic original or print used.

3. The method of producing printing plates, which consists in covering the metal plate with a sensitive layer comprising bi-chromate of ammonia, sugar and gum-arabic, exposing the same under a screen so as to produce on the whole surface of the plate square elements distinctly opaque and elements transparent at their geometrical centers which elements decrease in transparency from the center to the circumference, then developing the said plate, covering the plate with a sensitive layer comprising bichromate of potash, citrate of iron, sugar and nitrate of silver, allowing the said layer to dry so that it forms a film, then producing on said plate the image to be engraved by means of an exposure through an ordinary photographic original or print, and then subjecting the plate thus exposed to the action of a mordant.

4. The method of producing printing plates, which consists in covering the metal plate with a layer consisting of suitable proportions of water, bi-chromate of ammonia, sugar, gum arabic and a few drops of ammonia, exposing the same under a screen so as to produce on the whole surface of the plate square elements distinctly opaque and elements transparent at their geometrical centers which elements decrease in transparency from the center to the circumference, then developing the said plate in water, covering the plate with a layer consisting of

suitable proportions of water, beer, bi-chromate of potash, citrate of iron, sugar, albumen, glycerin, nitrate of silver and fish glue, allowing the said layer to dry so that it forms a film, then producing on said layer the image to be engraved by means of an exposure through an ordinary photographic original or print, and then subjecting the plate thus exposed to the action of a mordant.

5. The method of producing printing plates, which consists in covering the metal plate with a layer consisting of suitable proportions of water, bi-chromate of ammonia, sugar, gum arabic and a few drops of ammonia, exposing the same under a screen so as to produce on the whole surface of the plate square elements distinctly opaque and elements transparent at their geometrical centers which elements decrease in transparency from the center to the circumference, then developing the said plate in water, covering the plate with a layer consisting of suitable proportions of water, beer, bi-chromate of potash, citrate of iron, sugar, albumen, glycerin, nitrate of silver and fish glue, allowing the said layer to dry so that it forms a film, then producing on said layer the image to be engraved by means of an exposure through an ordinary photographic original or print, and then subjecting the plate thus exposed to the action of a mordant consisting of perchlorid of iron having a density varying between 34 and 45 degrees B. according to the intensity of the photographic original or print used.

In testimony whereof we have affixed our signatures, in presence of two subscribing witnesses.

AUGUSTE VALENTIN.
JEAN ZERREISS.

Witnesses:
JULIN CAECRN,
H. C. COXE.