May 18, 1948. F. G. YANES 2,441,609

PRINTING SURFACES AND PHOTOMECHANICAL REPRODUCTION GENERALLY

Filed April 18, 1944

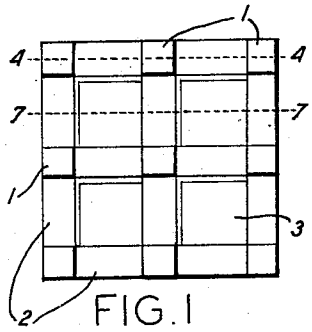


FIG. 1

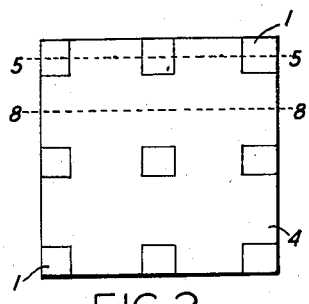


FIG. 2

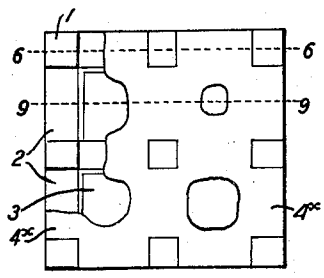


FIG. 3

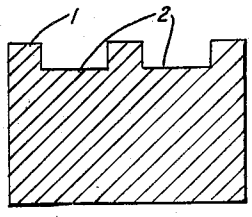


FIG. 4

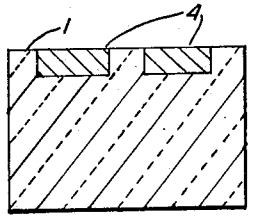


FIG. 5

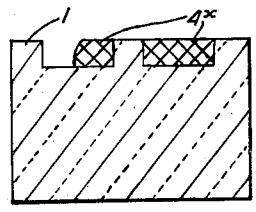


FIG. 6

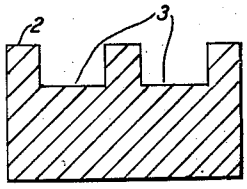


FIG. 7

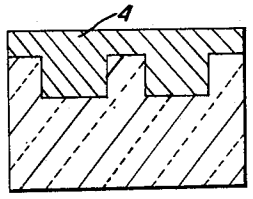


FIG. 8

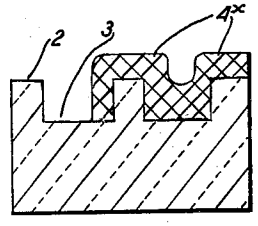


FIG. 9

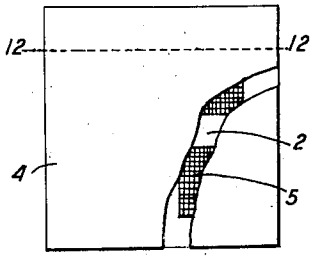


FIG. 10

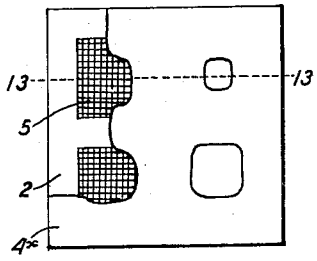


FIG. 11

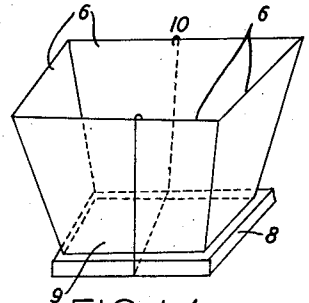


FIG. 14

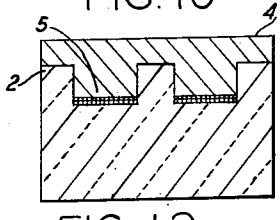


FIG. 12

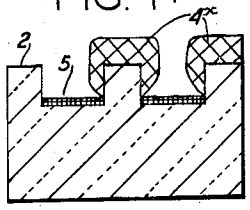


FIG. 13

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UNITED STATES PATENT OFFICE

2,441,609

PRINTING SURFACES AND PHOTOMECHANICAL REPRODUCTION GENERALLY

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Application April 18, 1944, Serial No. 531,566

20 Claims. (Cl. 95—5.6)

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The invention relates to improvements in printing surfaces, and photomechanical reproduction generally. It includes means, ways and products.

The main, though not the only purpose of the invention is to produce printable values similar to those obtained by photoengraving, photolithography, and with other varied textures.

While the invention includes some specific forms which are illustrated in the accompanied drawings, I wish it to be understood that I consider those examples not only combinatively novel, but also new in less combination than the whole, and some of its features capable of individual use as it will clearly appear in the course of the present disclosure.

Although the invention may be used in a number of processes, I prefer to practice it by means of a sensitive plate including a support combining plural relief patterns and a special coating. This plate, after suitably exposed under an ordinary negative, and treated, becomes transformed into a half-tone printing block.

In a Direct method of photomechanical reproduction described in Patent No. 2,234,997, issued March 18, 1941, I suggested a process of that kind. But the means and ways now utilized, the products obtained, and even the principle upon which the present invention is based, are different from those formerly proposed.

In the invention, the effects of light in depth and in surface are combined and increase both the height and the printing area of minute elements present in a relief pattern. In the former process above referred to, the height of the uniform minute elements is not substantially increased because the coating which supplied the additional matter ends at their vertices, while in the invention it surpasses the tops of the value forming minute elements.

When a regular half-tone print is examined under a magnifying glass, it can be noticed that the high-lights are represented by small dots of proportional size; and also that, as the tones develop, the pattern changes, as if the dots had grown four arms, and these little crosses in the tones and shadows become linked to each other and form a net of proportionally thickened cross-lines. This peculiarity of the classic process of photoengraving is, of course, explained by the way the image is formed, and by processing steps which cause the dots to close in those sections of the photoengraving negative corresponding to the high-lights. But such dual pattern is a fortunate achievement which contributes to the formation of the richest rank of tone values.

In the single patterned support of my formerly patented method, the uniformity of the small projections does not so favor the formation of tone values, for the graphic elements are developed by the exposure into larger but geometrically similar figures, dots into bigger dots, lines into coarser lines, but not dots into lines.

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The structure now suggested combines in the same body at least two different kinds of relief patterns at two different planes respectively. Of these, the outer one corresponds to a high-light tint and is purported for developing the high-lights while the inner pattern corresponds to a half-tone tint and is purported for the development of the tones and shadows. There are quite a number of relief patterns, both regular and irregular, which may be combined in the new arrangement, provided the high-light graphic elements of one pattern and corresponding sections of the half-tone graphic elements of the other pattern be both situated substantially in a perpendicular line in regard to the support, whereby, when the lower graphic elements are raised, as a result of the process, the upper ones become embodied and disappear into them.

When the new structure is utilized as support for a wash-off plate I prefer to combine a half-tone inner pattern formed by cross-lines, and a high-light outer one formed by dots, the small projections representing the last protruding at the crossing points of the lines. After this support is coated, up to the ending plane of the projections forming the high-light outer pattern, the problem presents itself of producing the photomechanical values at approximately the same operative plane, and as long as the half-tone, lower pattern, is under the printing surface, the first question is to raise those cross-lines by the effect of light in depth. Let us assume that this is done by exposing the plate through its support and under an ordinary negative to a beam of parallel light. With sufficient exposure, and in the sections corresponding to the tones in the negative, the lines of the lower pattern will be raised by additional thickness of hardened matter. At the same time the dots of the outer pattern situated in the same sections will disappear into the raised lines; while those remaining in those sections corresponding to the high-lights will be unaffected. Such effect of light in depth, of course, does not develop yet the photomechanical values in surface, for it merely brings the two patterns to substantially the same operative plane, and selectively so, for dots and cross-lines are then at their corresponding areas. But the fundamental effect in depth may be subsequently complemented by a side light action which will create values in surface proportionally to the transmission at different areas of the negative. This second part of the formation of the values may be attained in many different ways, through known optical operations, or even automatically, as in my formerly patented method where the effect of light in

depth also develops values in surface due to the angular shape of the projections. That result, however, is obtained in the present invention through a step to be later disclosed and which seems to be new in photomechanical reproduction.

Although a cross-line relief pattern is most suitable for developing a good rank of half-tone values, it appears inadequate for a single patterned support, because the minimum tint would be too gray to represent the conventional "whites" in half-tone prints. It has been found, however, in the process of the invention, that while the coating of a dual patterned support ends at the vertices of the high-light graphic elements of the outer pattern, the same coating, in regard to the inner pattern situated at a lower plane is, in fact, an overcoating. Therefore, if we eliminate from the dual patterned support the dotted outer relief, and still coat the plate as if it were present, the attainable result will be a photorelief with the richest rank of half-tones and in which the minimum dots have disappeared. The final print in this case will show "pure whites," as in the so called lithographic half-tones. This variation seems to be specifically new, for the fundamental single patterned relief will be a half-tone tint instead of a high-light one, and because the coating will not end at the printing plane of the tint plate but relatively far above the same.

It will be later noticed that the projections utilized in the chosen example of dual patterned structure have a shape which is different from that characterizing the graphic elements of my formerly patented method. In the last, the projections, whether dots or lines, actually have bodies decreasing in cross-sectional area and sharply ending at the same plane, a condition which is essential in that process because the transformation of the values in depth into values in surface is the result of the shape given by the relief pattern to the sensitive coating. Such is not the case in the present disclosure, where the formation of the photomechanical values is based upon an entirely new principle. It is possible, of course, to utilize the type of projections of my formerly patented method for building up the new dual patterned structure, and indeed that method would be improved by the better rendition of tone values achieved through the metamorphosis of the dot. But the reason I prefer the straight, prismatic, cylindrical, or wall like shape, in the projections of the new structure, is that this second form of graphic elements give the same impression always regardless of the printing pressure, while projections having an angular end are driven and penetrate into the printing bedding, and the more they do the larger the printed area and the grayer the high-lights at sections where a white effect is desired. If the invention were applied to my formerly patented method, the high-light graphic elements of the outer pattern, or at least the ending part of them, should preferably have a straight shape. In this last case the combination would include three different relief patterns, the lower of connected graphic elements decreasing in cross-sectional area for half-tones and shadows, the next of similar separate elements for the lighter tones, and the outer one of straight elements for the high-lights.

By selectively distributing suitable opaque matter at the spaces between the cross-lines of the transparent dual patterned support presented

as example, this is equivalent to a screen where the lines are the openings and the squares the pitch, as in photogravure. In this arrangement values in surface may be produced at and near the outer part of the coating by a similar technique as that utilized in photoengraving. But the complication of obtaining sufficient depth in silver emulsions, specially for coarse rulings, and the long exposure and elaborate installation required for utilizing in similar manner chromated mixtures, suggested the development of a ready system for producing the photomechanical values by contact printing under an ordinary negative. This other achievement complemented the practical value of the invention.

In my formerly patented method, as explained before, the photomechanical values can be automatically obtained by contact printing due to the angular shape of the projections. But it is not so when the graphic elements have a straight shape as those utilized in the example of dual patterned structure of the present invention. Through a long exposure there will always be some irradiation of the printing light, but never sufficient to develop the proper values at the outer surface of the sensitive coating. I found, however, that regardless of the straight shape of the projections the incidence of the printing light may be so controlled as to develop values in surface in a relatively short time, and I further discovered that even the form of the dot can be modified in contact printing, a result which seemed only possible by changing the outline or relative position of the camera stop in the regular photoengraving process. These achievements were accomplished by a system of mirrors suitably inclined and surrounding the area submitted to the illuminant. In this manner the printing light falls directly on the negative for the action in depth, and indirectly from the mirrors for the development of the values in surface. Varied effects may be attained when a single reflector has the outline of a truncated cone, or when plural ones are arranged as a truncated pyramid having a triangular base, the rotation of the mirror system in regard to the lines of the pattern also affecting the form of the dots. The four mirror arrangement is most suitable for the preferred dual patterned relief above discussed, the side corresponding to the top of the truncated pyramid touching the glass of the printing frame and surrounding the negative, while the more open side corresponding to the base of the figure projecting towards the illuminant. Suitably backed, the mirrors form a simple contrivance that is easily maintained in position by adequate means upon the printing frame. I am aware, of course, that the idea of changing the incidence of light is not new in general for contact printing, at least by two mirrors and for the slight enlargement required in reproducing certain color plates of the prior art. But the mirror surrounded area in contact printing solves an interesting practical problem and seems to be new in graphic reproduction.

The new combination of plural patterns in a single support may not only be useful in its normal relief shape but also in a reversed, cast-like form. In a method of Indirect photomechanical reproduction described in pending application Serial No. 424,582, dated December 27, 1941, now Patent Number 2,374,910, dated May 1, 1945, a mould is produced at once from which a half-tone block may be cast. This mould is obtained by selectively etching a reverse-relief pat-

tern. And the reversed form of the new dual patterned arrangement could be used with advantage in this case for the metamorphosis of the dot and the improvement of the values. The reverse shape of the structure, as a mould, is another article which may be utilized for casting or stamping the transparent supports for sensitive plates. Still another useful product may be obtained by giving the reverse shape to a coating held on a temporary support, as this can be exposed and then filled with suitable matter and cemented on a supporting surface before being submitted to the processing.

In order to facilitate the understanding of the present invention it may be convenient to remember the ways of the classical process. In regular photoengraving the original is photographed through a screen upon a plate, but in practice photoengraving should not be considered as a simple photographic variation. It is obvious that a negative taken through a screen, as the process-negative, should show a dotted image wherever there is a light effect, or better, a white field with black dots. However, in the actual process-negative only the half-tone and shadows are formed by black dots on a transparent field, because the high-lights are the opposite, namely transparent dots on a black background. In other words, the pattern of the high-lights is reversed. To reach such photographic contradiction the highlights are in the first place overexposed through the three stop known technique; then a very contrasty material is used that would hardly record the overexposure of the other values; and finally, for any disturbing halo that might have developed around the dots, a series of reducing or intensifying operations are resourced to which permit to say that the process-negative is practically remade and not just obtained by that automatism of the photographic operations. As to the positive, represented by the resist protecting the plate during the etching, it also appears with two different patterns of which one is reversed in regard to the other, for the high-lights are shown as minute black dots on a white field while the tones appear as small white dots of different areas on a black background. So the problem confronted in finding a system that would reverse the pattern in a positive by some automatic photographic step seemed an impossibility, specially when the positive had to be built on a relief-pattern already having the high-light values present and unchangeable. The high-light tint in a relief, as such, is satisfactory, because it will print small black dots on a white field as the "reversed" pattern of the positive high-lights in photoengraving. But as the half-tone and shadow values are not reversed and must show in the positive as white dots on a black background, it is obvious that a single high-light relief pattern formed by dots could not develop anything but bigger black dots, instead of white ones, on a white, instead of a black field. For that reason the question was not just to combine in a dual pattern structure a high-light and a half-tone pattern, but rather a negative and a positive pattern, a relief pattern for the high-lights that would develop dots of different sizes and a relief pattern for the half-tones that would develop, not dots, but a black background. So the cross-line pattern is, in fact, an example of pattern formed by connected graphic elements showing white areas surrounded by black separations which, after growing, develop the background for the required white dots of the half-tones and shadows, while the high-

lights remain represented in the other pattern by separate small black dots on a white field. And, all this, through the invention, is achieved automatically, by simple photographic manipulations.

In the following figures and detailed description some examples will be presented for demonstration which are not meant to limit the scope of the invention and its possible variations and applications.

In the drawings:

Fig. 1 is an example of a relief surface combining two patterns in the same structure. Two sections of this figure through the lines 4—4, and 7—7, respectively, are shown in Fig. 4, and in Fig. 7.

Fig. 2 represents the structure of Fig. 1, after this has been covered with a coating. Two sections of this figure through the lines 5—5, and 8—8, are respectively shown in Fig. 5, and in Fig. 8.

Fig. 3 is the product, after the coated element of Fig. 2, has been processed and transformed into a half-tone printing block. Two sections of this figure through the lines 6—6, and 9—9, are respectively shown in Fig. 6, and in Fig. 9.

Fig. 10 illustrates a relief surface having a screened single pattern of cross-lines which has been suitably overcoated. An area of the coating has been omitted in order to show the structure below. A section of this figure through the lines 12—12, is presented in Fig. 12.

Fig. 11 is the product, after the overcoated element of Fig. 10, has been processed and transformed into a half-tone printing block having "pure whites." A section of this figure through the lines 13—13, is shown in Fig. 13.

Fig. 14 presents a diagrammatic description of a contrivance and step for producing values in depth and in surface when printing by contact.

The structure in Fig. 1 combines a half-tone relief pattern of cross-lines 2, 2, surrounding the cavities 3, and a second high-light relief pattern formed by dots 1, 1, which protrude from the crossing points of the lines 2, 2. In the sectional view of Fig. 4, it may be seen how the dots 1, are arranged above the lines 2. And in the sectional view of Fig. 7, how the lines are raised from the cavities 3. For certain processes, like the example chosen for demonstrating the invention, the structure of Fig. 1, may be screened as the variation shown in Fig. 10; similarly the structure of Fig. 10, may be completely transparent. But it was considered unnecessary to illustrate two types for each kind of support, and so the one in Fig. 1 is shown as wholly transparent and the one in Fig. 10, as screened.

When examining the relief patterns combined in the example of Fig. 1, it must be understood that the drawing is purported for illustrating the relation between the combined graphic elements and not an exclusive materialization, as many possible variations are practicable within the same combination. And also that these variations of the example are only part of many others, for besides the production of values similar to those of photoengraving and photolithography a variety of other textures may also be obtained according to the main purpose of the invention. In the combination of dots and cross-lines, as explained before, the dotted pattern is a negative one, for it develops black dots on a white field; while the cross-line pattern is a positive one for it develops a black background for white areas. But between the positive and negative patterns there is a type which may be

termed neutral, for it may develop either one. Such is the pattern formed by lines in only one direction, although for the high-lights a very fine line is slightly grayer than the corresponding dotted pattern. The outer lines, however, may be built upon every other inner line and only in one direction upon a cross-line pattern, the results being then more satisfactory. Lines in one direction are preferable for the lower pattern and may be combined with dots raised at convenient distances along their tops. Lacking a better expression to describe the suitable type of graphic element for the halftone, lower pattern, the names of "continuous" or "connected" graphic elements have been adopted, as they surround empty areas and because lines are "continuous" and equivalent to projections "connected" in only one direction. The connected elements in the lower pattern are only essential when values are produced similar to those of photoengraving, but not for different textures. That the dots and lines in Fig. 1, are only representing the potential relation of the patterns may be further visualized by observing that in a cross-line pattern the tops of the lines may be formed by very close series of dots and still such pattern, for the purpose of the invention, is lineal, because the effect in depth of light through the thickness of the coating will produce the metamorphosis of the dots into lines just as it does for the high-light "separate" graphic elements in the sections corresponding to the half-tones. Similarly, a cross-line relief-pattern which has been produced by etching, in a dual-patterned structure, may show a slight curvature in depth at the tops of the lines between the protruding dots, and still the relation of the elements will be the same, for that slight arc will be flattened by the exposure into even lines at the surface of the coating. Thus, when the expression "connected graphic elements" is utilized in the description of the invention it must be read as meaning that the elements are linked in one or more directions at some sectional areas; in other words, that their transparency or potential structure is "connected" or "continuous" at the fundamental part of the relief regardless of their superficial appearance.

In Fig. 2, the structure of Fig. 1, is coated up to the plane passing by the tops of the dots **1**, **1**, which are visible at the surface of the coating **4**, while the lines have disappeared under it. This is better seen in Fig. 5, where the sectional view shows the dots and the coating terminating at the same plane, while in Fig. 8, the coating ends relatively far above the plane passing by the tops of the lines. In regard to this figure, the limitation of the coating to a plane passing by the tops of the dots should be read as a descriptive expression purported to illustrate the potentiality of the combination, for in practice, and for some types of separate graphic elements, it may be convenient to slightly overcoat the high-light pattern. Obviously, as there will not be any light effect at the high-light sections, the slight overcoating will disappear from there during the processing, but the relative difference of height between the high-lights and other values will be increased and the printing pressure correspondingly lessen on the whites of the print.

After the coated element of Fig. 2 has been processed, the product has the appearance shown in Fig. 3, where part of the coating **4***x*, has become insoluble and remains, and part has been dissolved away leaving uncovered some of the

dots **1**, lines **2**, and cavities **3**. In the sectional view of Fig. 6, it may be seen how the dots are embodied and disappear into the raise lines at the half-tone an shadow areas, while at the high-light sections they remain isolated and furnish the dotted pattern representing the conventional "whites" in half-tone reproduction. At the same high-light areas the lines **2**, remain under the printing plane and do not show in the impression. But in the half-tone and shadow areas, as shown in Fig. 9, the lines **2**, are raised to the operative plane and develop values in surface whose formation will be later discussed.

The coated element shown in Fig. 10, includes a supporting structure having only one transparent relief pattern of cross-lines **2**, **2**, and it would be identical to Fig. 2, if it were not because the dots **1**, **1**, are absent, for even the coating, or rather the overcoating of the lines, is the same, as it may be seen by comparing Fig. 8, and Fig. 12. Another feature added to this type of element, and which may be useful for producing the values in surface through certain optical operations, is the screening means **5**, which appears at the bottom of the cavities and in the spaces between the cross-lines. This gives the supporting structure the appearance of a photogravure screen in which the openings or lines are in relief. The support in Fig. 10, may also be used without the screening means, as already explained. The screening means **5**, has been illustrated as black or opaque as preferable for general purposes. But when the values are to be formed by contact printing, as in the chosen example, a partial absorption of light would do it sufficient to reduce the thickness of hardened matter at the bottom of the cavities for convenient depth of the printable values.

In Fig. 11, the product obtained from the element of Fig. 10, is illustrated. For the sake of comparison it has been assumed that the subject which has been reproduced is the same as in Fig. 3. The outer areas of the undissolved coating **4***x*, are substantially the same in both products, as it may be seen by comparing Fig. 9, and Fig. 13; but the bare dots **1**, present at the high-lights of Fig. 3, are missing in Fig. 11. When printed, the element of Fig. 3, will show dotted high-lights, while that of Fig. 11, will have "pure whites," as the so called lithographic half-tones.

In Fig. 14, the diagram shows four mirrors **6**, **6**, whose arrangement follows the outline of an upside-down truncated pyramid of rectangular base. The top of the figure is positioned in contact with the glass of the printing frame **8**, so as to enclose the area corresponding to the negative **9**, while a rubber band and clips **10**, hold the contrivance in place for the exposure. The figure is purported to illustrate the device and the step for producing in contact printing a similar effect as that obtained by the camera in photoengraving for the formation of photomechanical values.

For practicing the invention I begin by producing the structure of Fig. 1, in a master plate from which I take a mould and subsequently as many casts as I may need. Or I may at once produce a reverse structure from which I cast the dual patterned relief. In the example presented the ratio of the cross-line pattern is 1:2, in order to facilitate the graphic difference between dots and lines, but I may use any other suitable ratio as the usual 1:1 in photoengraving or the 1:4 in photogravure. When mechanical

engraving is utilized the master plate is made in three successive operations: first a reverse pattern of cross-lines is cut with a suitable stylus on a metallic surface, the depth of the grooves adding the height of both lines and dots; then a cast is taken from that plate; and finally the protruding lines are cut down mechanically, so as to give the lines their proper height except at the crossing points where the dots remain protruding as required. From the master plate I may take a mould by electroplating; or in many other known ways. When the mould is finished, I stamp with it some transparent, pressure resistant material, as some plastics on the market, which are suitable for the example chosen in the present disclosure.

There are other ways of producing the master plates. For instance, a small section of the dual pattern may be engraved by hand, and then plural matrices taken in order to multiply the relief in the fashion of type-casting or in that of typesetting machines. It is also possible to cut down a mechanically produced cross-line relief pattern as in re-etching, carrying the operation far enough as to undercut the lines, which at the crossing points offer more resistance, thus leaving protruding dots. A mould may also be directly produced by forming a resist of parallel lines on a metallic surface and etching it; forming then a second resist perpendicularly to the first, and etching the plate again; whereby the plate will be etched twice at the crossing of the lines and the grooves will cast protruding dots at those sections. The same result may be obtained through a carbon tissue resist suitably exposed, and in many other ways.

While the dual patterned relief may be conveniently cast in plastics for the use herefrom presented as an example, the structure may also be produced in opaque and even flexible matter for other purposes, as there are several relief-processes in which it could be utilized, and also varied ways of adding supplemental values to the fundamental relief pattern of the invention.

For wash-off process purposes I coat the dual pattern relief of transparent plastics with a sensitive composition. This may be a suitable silver emulsion, but I will prefer for demonstration a simple mixture of chromated gelatine which I extend on the support on its relief side and in sufficient quantity as to fill it, when dried, substantially up to the ending plane of the projections forming the high-light outer pattern. When instead of using the structure of Fig. 1, as a support, I utilize the single patterned one of Figs. 10, the amount of coating is substantially the same, so that the cross-line pattern will be equally overcoated in both cases. After the plate is dried I expose it through its support under an ordinary photographic negative, and for that exposure I place and fix on the printing frame the mirror system illustrated in Fig. 14.

When the illuminant falls upon the negative, assuming that the beam is of parallel light, which may not be indispensable, the light effect is produced in five directions, one straight from the source of light; which only develops values in depth and, by hardening the coating, automatically raises the cross-line relief pattern to an operative plane; and in four more directions from the mirrors, each one sending light at any desired incidence, which develops values in surface at the outer part of the sensitive coating. The light in this last case penetrates the transparent projections of the support in angular

way and affects the part of the coating present at the sides rather than that above the tops of the graphic elements in the crossed-line pattern.

After exposed the plate is treated in wash-off way as to dissolve the unhardened part of the coating. When dried, the product is finished and can be proofed, mounted and printed.

The support of Fig. 10, when wholly transparent, is similar to a structure known to the art which was suggested for producing pseudo-gravure printing plates by the wash-off process. And the same may be said of the coated plate, although the similarity in both cases is only apparent. In regard to the old support it must be noticed that according to authorities the depth of gravure pockets is not greater than 3 thousandths of one inch. For the purpose of the invention a depth of 3 thousandths of one inch is much shorter than what is necessary, as we are now producing pseudo photoengraving and not intaglio plates. The known average depths for different rulings in printable half-tone blocks are in thousandths of one inch:

Screen lines	High-lights	Half-tones	Shadows
55	8	5	3
85	4.6	3.1	2.2
100	3.2	2.2	1.4
120	2.5	1.7	1
150	2.2	1.4	0.9
175	1.8	1	0.6

If we assume that in a wholly transparent support the height of the lines or walls is only 3 thousandths of one inch, and that the thickness of the coating above the lines is also 3 thousandths of one inch, it is obvious that the light effect in depth only, which hardens and raises the lines to the operative plane, will also raise the bottom of the cavities in the same 3 thousandths of one inch, and the height will not be changed. But when the values in surface are produced by the lateral effect of the light, there is an additional thickness to be subtracted from that depth which may reduce in more than one half the assumed 3 thousandths of one inch. I have found that for rulings which may be considered as coarse, like 55, 85 and 100, the height of the lines will not be sufficient even if they are given the high-light depth, because the additional side light effect so reduces that depth that it would not meet the numbers of the second column; and further, that it is necessary to give them an extra height. The pockets for these coarse rulings may require a depth in thousandths of one inch approximately of 11-to-12 for 55; 6-to-7 for the 85; and 4.5-to-5 for the 100 line rulings, which is about from two to four times the maximum depth of 3 thousandths of one inch in gravure pockets. For finer rulings, as 120, 150, and 175 lines, the situation is more aggravated because the amount of matter is greatly reduced and the irradiation of the printing light together with the reflections and glare in the wholly transparent support calls for a height of more than twice the corresponding average high-light depth. It may be safely established that for a transparent support the height of the walls should be from about a minimum of 5 for the fine to about a maximum of 15 thousandths of one inch for the coarse rulings, respectively, and cavities of that depth are not gravure pockets nor could they be used as such. The requirement of depth in the support of the invention is a condition of operativeness for a new purpose which does not suit the old one. And such new

support is an article of manufacture which may be coated by the worker himself.

Another solution for the problem of printing depth is illustrated in 5, Figs. 10, 11, 12, and 13. Such or any other equivalent means suitable for attenuating or eliminating the effect of light in depth at the bottom of the pockets, permits to raise the height of the lines 2, by hardening the coating above their tops, without producing the same effect at the bottom, thus gaining in printing depth, while the lateral action of light at a suitable incidence will not have any substantial effect on it. Naturally, the screened support allows much more margin for shortening the height of the graphic elements in the relief pattern to the minimum operative depth, favoring definition, and even economy. But while the height of the walls in the screened element may fall now for some rulings within the depth of gravure pockets, such screening means brings another differentiation, because it would be contrary to wash-off intaglio anything that would interfere with the passing of light through the bottom of the pockets, as it is through those transparent areas that the values are formed, while in the process of the invention the useful exposure is only the one made through the walls and not through the pockets of the support.

A relief pattern provided with screening means is not new in the art in general. In my formerly patented method of reproduction a similar arrangement may be found among variations of the support. In that case, however, the opaque sections form a cross-line pattern of black lines as in a photoengraving screen, while in the invention the operative structure must have transparent connected sections as in photogravure. The screened support of the invention is further differentiated from photogravure screens in that these have the pitch and the openings at the same level in order to secure good contact with the carbon tissue, while in the support of the invention the transparent lines are raised and even printable as a relief surface.

In regard to the coated plate, which may be sensitive to light or susceptible of being sensitized, the novelty of the combination is not only in the supporting element, but in the coating element, for the thickness of this does not end at the plane where the walls terminate but relatively at a much higher plane, as shown in Fig. 8, which is a section of Fig. 2, but would be identical to a similar section of Fig. 10, with a wholly transparent support. The extra thickness of coating in this case may corespond to the average depth of the half-tone values in printable blocks, and in practice it must be such that when some of the lines have been raised to the end of the coating, those other lines which remain bare will not print. This is another difference with the sensitive plates in pseudo-intaglio processes. where the coating must not project beyond the plane passing by the tops of the walls, and with the sensitive elements of my formerly patented method in which the coating ends substantially at the vertices of the projections. And so, whether provided with a wholly transparent or screened support, the sensitive plate of Fig. 10, is also a new and useful article of manufacture.

The contrivance illustrated in the diagram of Fig. 14, considerably shortens the exposure. In sunlight a four mirror system will throw upon the image area about five times the normal amount of light. This will counteract the low sensitivity of certain mixtures, and in comparison with any system in which the normal amount of light would produce both the effect in depth and in surface, that of the invention is obviously much faster. In photomechanical reproduction, the new device solves a most interesting problem by achieving results that formerly were only obtained by means of the camera in the classical process. The new article may also find some applications in photography and may be manufactured to fit different standard sizes of printing frames.

As to the novelty of the products we must consider first the one illustrated in Figs. 3, 6, and 9, which is built upon a dual pattern structure, and then that of Figs. 11 and 13, which renders a half-tone impression with pure whites. Both products are seemingly new and both are useful. The printing plate of Fig. 3 is differentiated from the products of my formerly patented method of reproduction in that the half-tone printing areas are not black dots on a white background but white areas on a black field because they are not developed from high-light printing elements carrying different amounts of additional matter but from a half-tone pattern formed by connected elements which develop a black background and are raised by the exposure to the operative level of the values. The printing plate of Fig. 11 is differentiated by the fact that the single relief pattern is not formed by separate and sharply ending elements of high-light printing areas but by a half-tone pattern of connected elements, and because the values are formed above and not at the ending plane of the pattern, for the whites are pure, without the minimum dot. In fact the product of Fig. 3 is the same as that of Fig. 11, with additional dot printing projections at the white areas to match the appearance of regular half-tones.

That the two forms of the invention are not a superfluous repetition of the same preferred result may be easily realized in practice, for half-tone values for lithographic purposes may be obtained through the invention and suitably transferred, a case in which the minimum dot in the high-lights is undesirable. On the other hand, while half-tone blocks with pure whites may also be utilized in typographic printing, it would all depend upon the size of the white areas, for when these are too large the minimum dot is necessary. It may be said, however, that the possibility of cutting off sections from a plastic plate is much easier than routing, should the pure white kind of impression be specially desired. Such possibility has been taken in consideration when limiting the thickness of the overcoating in the element of Fig. 10, to approximately the average depth of half-tone values in printable plates, for while the overcoating could be somewhat thicker, the thinner it is, the better the definition and the finer the results.

About the coating 4, adopted for the demonstration, and which has been described as a simple mixture of chromated gelatine, this does not necessarily imply that it should be used plain, for there are many additions well known by those skilled in the art which may favor the results of the processing. Some dyes may conveniently modify the transmission of light through the coating; and some pigments, or unsoluble precipitates can be added which facilitate the inspection during the development. Of these I may utilize some which set at the bottom of the cavities and provide selective screening means; or I may deposit some light screening matter at the bot-

tom of the cavities before the coating is spread and incorporates it, etc. It must be explained, besides, that when coatings are described as "sensitive matter" in the present specification, it does not precisely mean that they should be so when applied to the supports, but at the moment of using the articles, for specially in bichromate variations, as the chosen example, it is rather convenient to sensitize the elements shortly before using them; thus by "sensitive" to light it must be understood both those coatings which are actually sensitive and those which are susceptible of being sensitized. The expression "sensitive matter," instead of "sensitive coating" has also been preferred, because the matter may be applied to several coatings, and even in different coatings including emulsions of varied composition or chromatic sensitivity, and that expression generically covers secondary variations which would be prolix to enumerate.

We have so far discussed the production of values similar to those obtained by photoengraving and photolithography, but a variety of other textures may also be obtained according to the purpose of the present invention.

The new way of producing photomechanical values in relief patterns having projections of straight shape and thus more adapted to changes in the printing pressure without a darkening effect in the high-lights, lends itself to obtain a variety of other textures in values formed upon relief-patterns with less combination than the types illustrated in Fig. 1 and Fig. 10. Such variations may utilize dual and even single patterned supports already known but heretofore never utilized in a sensitive plate. Or they may employ new structures simplifying the features of the examples, as dual patterns may be combined independently at different levels, or one built upon the other without graphic elements of the "connected" kind in the lower pattern. It is obvious, of course, that the more such patterns approach the preferred illustrated types the better the rendition of the tones. But this cannot be stated as a rule, because in a system of exposure which sends light from several directions at any suitable incidence, many a pattern of apparently disconnected elements may link those elements laterally, just as the effect of light in depth equals the height of elements situated at different levels. And the further step of modifying the form of the texture by convenient rotation of the reflectors also offers the possibility of breaking the monotony of known patterns for the most varied effects.

The novelty of the coating element in the plate combination, in a thickness surpassing the level of a relief pattern in sufficient printing depth, is not only a condition in the preferred sensitive elements of Fig. 2 and Fig. 10, but a combination itself which may prove to be very useful in modern reproduction processes. A support having a dual or even single patterned relief formed by projections of high-light printing areas, when so overcoated, will permit to produce a line design in raised values without resourcing to routing because, besides the depth of the values, the pattern at the bottom will provide a safeguard by furnishing a very fine dotted texture in which the printing pressure will be so lessened as to make it practically invisible in eventual impression, depth and fineness which can hardly be produced by etching in the classical process. It is an ideal combination which

I have successfully used for speedy reproduction of text from photocomposing machines.

During the course of the above description same as in the claims defining the invention a geometrical language has been adopted to facilitate the understanding of the principle and materialization of means, ways, and products. Terms have been employed such as cones, triangles, bases, vertices, ending planes etc. As such language may convey a mathematical and exact meaning it must be understood that within the limits of operativeness, it is not meant to so limit the invention in practical manufacture.

After having described to the best of my knowledge the new and useful improvements, I wish to be understood that the present disclosure is for the purpose of illustration only and that the invention includes any variations, equivalents and applications within the scope of the following claims.

I claim:

1. In photomechanical reproduction, a foundation which combines in the same body plural elevated designs of different heights, each of said designs formed by a number of minute elevations which for the same design substantially have the same area, the minute elevations in the lowest design raised from the bottom of the structure, and those of successive designs built upon the minute elevations of the design below and correspondingly showing a lesser area.

2. In photomechanical reproduction a support combining at least two different relief formations in successive elevation, the first of said formations showing an evenly distributed number of small projections, and the second formation exhibiting a second number of minute projections of lesser area built upon those of the first formation, said support presenting a sectional appearance of a half-tone tint at a plane passing by the tops of the first number of projections, and that of a high-light tint at a plane passing by the end of those of lesser area.

3. In photomechanical reproduction, a relief surface combining two different groups of graphic projections, respectively situated at two different planes, and one built upon the other, the first group of projections consisting of connected small elevations from the bottom of the structure, and the second group of smaller and disconnected elevations from the tops of the connected ones.

4. In photomechanical reproduction, a base showing a bottom, a first elevation from this bottom exhibiting a graphic texture of small projections, and a further elevation from the top areas of these projections forming a second and finer graphic texture of uniform projections of lesser area.

5. A photographic support embodying the combination of two relief formations situated one upon the other, the lower formation exhibiting a number of light transmitting and continuous minute elevations raised from the support, and the upper formation showing separate minute elevations of lesser area raised at sections of the continuous ones.

6. An element showing the reverse relief of the structure described in claim 1.

7. An element showing the reverse shape of the structure described in claim 3.

8. In photomechanical reproduction, the combination in a unit of a tint plate suitable for typographic printing and a photogravure screen, said tint plate showing elevations and depressions, the elevations corresponding to the openings of the

screen, and the depressions to the pitch of the same, said elevations presenting the appearance of transparent thin walls of straight shape and uniform height limiting opaque areas.

9. In photomechanical reproduction, a wholly transparent support for a sensitive coating, said support showing at one side wall-like elevations of straight shape surrounding pocket-like depressions in arrangement similar to a shadow section in a screened gravure plate, except that the depth of said depressions surpasses in more than one half the operative known maximum depth of gravure pockets, the depth of said depressions also surpassing the average known depth of the highlights in printable half-tone blocks of equivalent ruling.

10. In a photographic element, a light-transmitting support showing on one side two different series of minute elevations at different levels, the higher elevations having a smaller area than those of the lower series, and matter sensitive to light coated on said support at least to the top of the higher elevations.

11. In a photographic element, a light-transmitting support provided on one side with two different relief patterns, one of said relief patterns formed by minute and separate projections representing a high-light tint, and the other relief pattern formed by connected projections representing a half-tone tint, the projections in the first pattern built upon sections of those in the second pattern, and matter sensitive to light filling the relief of the combined patterns up to a height at least equal to that of the high-light projections.

12. In a photographic element, a support having on one side a sensitive coating, said support provided on the coated side with at least a series of minute projections forming a printable tint; both the projections and the areas in the support from where they are elevated transmitting light and offering a path to it for reaching from the uncoated side the inner sections of the coating surrounding and covering the minute projections; said coating having a thickness which when retained at some places will make the difference in height such between the coating and the support that the minute projections will not print.

13. In a photographic element, a transparent support showing on one side pocket-like minute depressions surrounded and isolated by wholly connected walls, the depth of said depressions from about two to four times the known maximum operative depth of gravure pockets, and matter sensitive to light coated on this side of the support in a thickness surpassing the height of the walls in at least the depth of half-tone values in printable blocks of corresponding ruling.

14. In a photographic element, including a transparent support having on one side at least one relief design formed by wholly connected projections surrounding and isolating pocket-like depressions, matter sensitive to light coated on said support, and second matter capable of absorbing light mixed with the sensitive matter at the bottom of the depressions.

15. The method of producing by wash-off a half-tone block with values similar to those of photoengraving which consists in, first, providing a transparent support having on one side two relief patterns of different heights, the higher pattern formed by minute and separate graphic elements representing a high-light tint, and the lower pattern formed by connected graphic elements representing a half-tone tint, the graphic elements in the higher pattern being raised sections of those in the lower one; second, coating said support with matter susceptible of being selectively and proportionally hardened at the areas exposed to light, the thickness of that coating reaching the tops of the graphic elements in the higher relief pattern; third, exposing to light the coated plate through its support under an ordinary negative so as to reach the surface of the coating with the light effect in those sections corresponding to the tones of the image; fourth, further submitting the same to light of suitable incidence from several directions around the area of the printing negative; and fifth, treating the exposed coated plate by the wash-off process.

16. The method of producing by wash-off a half-tone block with pure whites similar to those of photolithography, which consists in, first, providing a transparent support having on one side a relief pattern formed by connected graphic elements representing a half-tone tint; second, coating said support with matter susceptible of being selectively and proportionally hardened at the areas exposed to light, said coating surpassing the level of the relief in a thickness sufficient to make the same unprintable when areas of the coating are retained upon it; third, exposing to light the coated plate through its support under an ordinary negative so as to reach the surface of the coating with the light effect in those sections corresponding to the tones of the image; fourth, submitting further the same to light of suitable incidence from several directions around the area of the printing negative; and fifth, treating the exposed coated plate by the wash-off process.

17. The method of producing a printing block which consists in first, providing a support for a sensitive coating having on one side at least one design in relief exhibiting a number of elevated and minute graphic elements forming a printable tint, said minute graphic elements and the sections in the support from where they are elevated both transmitting light and offering a path to it for reaching from the other side of the support the inner areas of a coating surrounding and covering said minute graphic elements; second, coating said support with matter sensitive to light in amount to surpass the tops of the elevated minute elements in a thickness sufficient for making the same unprintable when portions of the coating are retained thereon; third, suitably exposing the coated plate through its support under an ordinary negative so as to reach with the light effect the sensitive matter both upon and around the minute elevations in proportion to the values of the printing negative; and fourth, submitting the exposed plate to a relief process capable of removing the coating from the support except in those areas occupied by the values to be reproduced.

18. A printing block, including a base showing a number of minute elevations of which some are substantially bare and some others carry different amounts of additional matter increasing their height and width to form printable relief values which coincide with those minute elevations upon and around which they are respectively built, each one of these values being thus necessarily supported at least by one minute elevation; the thickness of said additional matter raising the printing plane of said values to a level which makes the bare sections unprintable.

19. A half-tone block, including a base, a

graphic texture elevated from said base, and different amounts of additional matter retained thereon; said graphic texture formed by wholly connected projections in wall formation surrounding and isolating pocket-like depressions, some of said elevated walls appearing substantially bare at the sections of the high-lights, and some others increased in height and width by said additional matter to form half-tone and shadow printable values which coincide with those connected projections upon and around which they are respectively built; the thickness of said additional matter raising the height of said values to a level which makes the bare projections unprintable.

20. In a half-tone block, a relief pattern formed by connected graphic elements representing a half-tone tint, said graphic elements having raised sections forming a second pattern of separate graphic elements representing a high-light tint, additional amounts of matter substantially raising the height and increasing laterally the areas of the connected graphic elements up to the level of the separate elements, said additional matter forming half-tone and shadow printable values, and the separate elements representing the high-light tint remaining partly embodied into the matter raising the connected graphic elements, and partly standing separately and furnishing a dotted pattern for the high-lights.

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