

A. B. PORTER.

DECORATED SURFACE AND METHOD OF PRODUCING SAME.

APPLICATION FILED JUNE 23, 1902. RENEWED MAY 25, 1903.

NO MODEL.

Fig. 1.

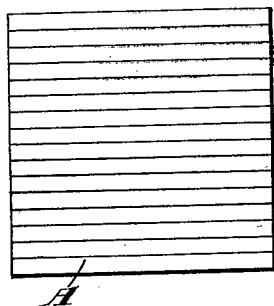


Fig. 2.

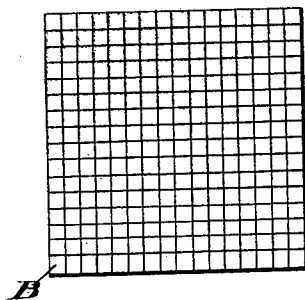


Fig. 3.

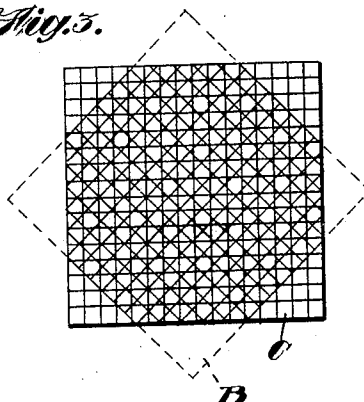


Fig. 5.

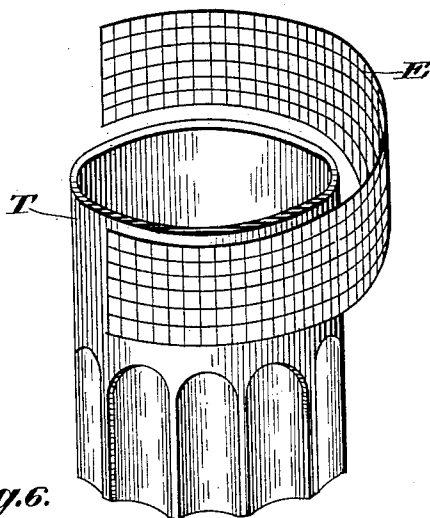


Fig. 4.

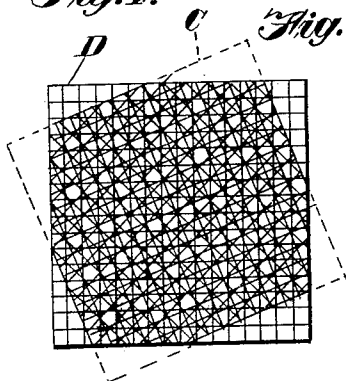
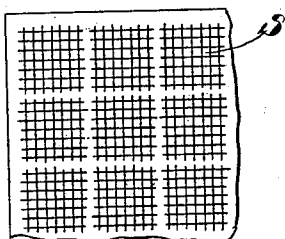


Fig. 6.



Witnesses:

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UNITED STATES PATENT OFFICE.

ALBERT B. PORTER, OF EVANSTON, ILLINOIS.

DECORATED SURFACE AND METHOD OF PRODUCING SAME.

SPECIFICATION forming part of Letters Patent No. 734,134, dated July 21, 1903.

Application filed June 23, 1902. Renewed May 25, 1903. Serial No. 158,685. (No specimens.)

To all whom it may concern:

Be it known that I, ALBERT B. PORTER, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Decorated Surfaces and Methods of Producing the Same, of which the following is a specification.

This invention relates more particularly to the decorating of the surface of glass, metal, and other ware with crossed diffraction-gratings for the purpose of producing colored-light effects.

It is already well understood that a surface provided with a single grating or one consisting of a single set of parallel lines will produce a brilliant display of spectrum colors, and to an extent may be said to be a "decorated" surface. With such single gratings, however, the color effect will be seen only when the surface is looked at from approximately one direction, and this fact practically offsets the value of ordinary diffraction-rulings as a means of producing decorative effects. This difficulty is done away with if instead of a single set of parallel lines the grating consists of a plurality of sets of parallel lines crossing each other angularly, so as to diffract the light-rays in different directions and produce the highly-colored rainbow appearance no matter from what direction the surface so decorated is viewed. It is, however, practically impossible to directly rule a diffraction-grating having crossed sets of lines, owing to the chattering or jumping of the cutting-tool or diamond as it passes over the intersecting lines previously ruled.

The present invention therefore contemplates a photographic method of producing surfaces decorated with diffraction-gratings consisting of intersecting sets of parallel lines, straight or otherwise, and further contemplates the multiplying of such sets of lines to any desired extent, starting from an original diffraction-grating having but a single set of such lines, which may be ruled on a dividing-engine or may be otherwise provided. For example, the invention contemplates the decorating of surfaces by two sets of parallel lines crossing each other at about right angles or four sets crossing each other at angles of approximately forty-five degrees or even greater

numbers of sets crossing each other at still lesser angles or at other angles than above mentioned, it being understood that the number of the intersecting sets of lines or the angles at which the different sets of lines cross each other is not of the essence of the invention and may be widely varied with substantially the same result.

In carrying out my improved process a start is made with a diffraction-grating having but a single set of parallel lines, which, as above indicated, may be ruled on any suitable glass plate or transparent film by a dividing-engine or like machine or may be photographically made from some other plate which has been so ruled. A second grating is then made from the first one by taking a blank photographic plate provided with a sensitized surface, placing the first grating ruled face downward upon the sensitized plate, and making two partial exposures of the plate to the light, the second part of the exposure being made after the plates have been relatively rotated through a greater or less angle from the positions occupied by them during the first part of the exposure. The sensitized plate is then developed, and if great care has been taken to not unduly prolong either part of the exposure the surface of the second plate when developed will show a diffraction-grating comprising a double set of intersecting parallel lines, each of which will be a duplicate of the lines originally provided on the first grating. A third grating may then be made from the second by placing the latter face downward against another blank sensitized plate and subjecting them to two partial exposures, of which the second is made after the plates have been rotated, as before, through a greater or less angle from the relative position occupied by them during the first part of the exposure. This third plate when developed will then show a diffraction-grating consisting of four intersecting sets of parallel lines and may be used as a master-plate, by which to print in two positions upon a fifth sensitized plate, and so on by using each plate in turn as a negative with which to print upon a new sensitized plate in two positions the number of sets of lines constituting the newly-printed diffraction-grating will be doubled each time

the operation is repeated until the number of sets of lines ultimately desired for the grating or decorated surface will have been obtained.

5 In the further carrying out of my invention it will also be understood that at any stage of the process the photographically-printed gratings may be etched into the printed surface, and thus made a permanent decoration of the article whose surface is so
10 printed. Cut glass in particular lends itself readily to this process of decoration, and glassware thus treated will present to the eye a marvelous showing of spectrum colors, especially when exposed to the rays of a multiplicity of electric or other artificial lights.
15 This style of decoration is, however, not confined to glassware alone, but may be applied to metal, pottery, and other ware, on which it
20 will effect the same result in greater or less degree.

The invention consists in the matters thus and hereinafter set forth, and particularly pointed out in the appended claims, and will
25 be readily understood from the foregoing and following descriptions when considered in connection with the accompanying drawings, in which—

Figure 1 shows a diffraction-grating consisting of a plate or film ruled with a single
30 set of parallel lines, the distances between which are greatly exaggerated in order to make the illustration plain. Fig. 2 is a similar view of a diffraction-grating consisting of
35 two sets of parallel lines intersecting each other at right angles and produced photographically by repeated exposures of the grating shown in Fig. 1. Fig. 3 shows a diffraction-grating consisting of four intersecting
40 sets of parallel lines similarly produced by repeated exposures of the second grating. Fig. 4 shows a diffraction-grating consisting of eight intersecting sets of parallel lines photographically produced by repeated exposures
45 of the third grating. Fig. 5 is a perspective view illustrating the manner in which a flexible film provided with a diffraction-grating consisting of a plurality of intersecting sets of parallel lines may be applied to a glass
50 tumbler for the purpose of decorating the latter in accordance with my improvement. Fig. 6 indicates the manner in which a diffraction-grating of large area may be produced by repeatedly printing a previously-prepared master plate or grating in successive spots over
55 the surface of a plate or film.

Referring to said drawings, Fig. 1, A designates an original grating consisting of a glass plate or flexible transparent film having
60 on its surface a single set of parallel lines which may be ruled thereon by a dividing-engine or similar machine or may be made photographically from some other plate which has been so ruled. These lines are herein
65 shown as straight lines, but are not necessarily so. From this first grating A a second plate B, Fig. 2, may be made by taking a

blank photographic plate or film provided with a sensitized surface, placing the first grating ruled face downward upon the sensitized plate or film, and exposing it to the light
70 in two positions, the second part of the exposure being made after the plates have been relatively rotated through any desired angle, in this instance shown as ninety degrees. The
75 sensitized plate is then developed, and if care has been taken not to unduly prolong either part of the exposure the surface of the plate will show a double set of ruled lines intersecting each other, as shown in Fig. 2, instead of
80 the single set shown in Fig. 1. The plate preferably used is either one having a gelatinous surface sensitized by potassium bichromate, which may be developed by simply being immersed in tepid water and allowed to dry, or
85 may be one having a sensitized surface produced by a solution of bitumen and benzol, which may be developed by soaking in turpentine and washing off with alcohol. A third diffraction-grating C, Fig. 3, may now
90 be made, if desired, by placing the second grating B face downward against another blank sensitized plate or film and exposing to the light in two positions, the second part of the exposure being made after the plates have
95 been relatively rotated through any desired angle, herein shown as forty-five degrees. This prints the crossed lines of grating B twice upon the plate C, and when developed the latter plate will consequently present a
100 ruled surface consisting of four sets of parallel lines, as shown in Fig. 3. A fourth grating D, Fig. 4, may now be made from grating C by following the same general procedure as that employed in making grating
105 C from grating B or grating B from grating A—that is to say, the fourth grating is placed with its ruled face downward against the sensitized surface of another blank plate or film and subjected to two partial exposures to the
110 light, the second of the partial exposures being made after the plates have been relatively rotated through any desired angle, in this instance shown as twenty-two and one-half degrees. Thus when this fourth grating is developed
115 its surface will appear ruled with eight intersecting sets of parallel lines, as shown in Fig. 4, and so by using each grating in turn as a negative from which to print upon a fresh sensitized plate in two different
120 positions the number of intersecting sets of lines appearing upon the newly-printed plate will be doubled each time the operation is repeated. Thus the fourth grating D of the drawings when twice printed upon a fifth
125 sensitized plate will produce sixteen sets of lines upon the latter, and if the fifth grating thus produced be in turn printed upon a sixth sensitized plate the latter will develop thirty-two sets of lines, and so on indefinitely, the
130 process being only limited by the increasing difficulty as the number of sets of lines increases of moving the master-plate or printing-grating through a small enough angle be-

fore the second exposure to avoid bringing the sets of lines into coincidence. In practice, however, I have found no difficulty in producing plates containing over a thousand sets of lines without reaching the limit of possibilities in this direction.

The number of partial exposures is not necessarily limited to two, but may be three or more, providing the subdivision is not carried so far as to result in a dim or indistinct imprint of any of the sets of lines. I have, however, obtained the best results by simply exposing each plate twice after the manner hereinbefore described. Neither is the exact angle through which the plates are relatively moved between the partial exposures an essential matter, especially when the process is carried on through a considerable number of stages, the linear formation of the resulting screen completely disappearing, to all appearances, as the number of sets of lines is multiplied into the hundreds. Starting with an original grating ruled with three thousand lines to the inch, for example, I have found that when the number of sets of lines is increased to two or three hundred the lined surface appears under the microscope as covered with a multiplicity of dots, without any semblance of lines whatever. In the accompanying drawings the number of lines to the inch is reduced to a very few for the sake of clearness of illustration, it being of course impracticable to graphically represent anything like the number of lines to the inch actually employed in diffraction-gratings of this character.

At any stage of the process thus described the photographically-printed lines may be etched into the printed surface and the decoration thus made permanent. When such etching is contemplated, the best results are obtained by the use of the bitumen solution for sensitizing the surface. Such surface after being printed and developed is subjected to the action [of an etching-acid, and where the material to be etched is glass hydrofluoric acid will preferably be employed. The surface may be subjected directly to the action of the acid or may be merely exposed to the acid-fumes, and I have obtained the best effects by this latter method. For etching on metals or other materials than glass nitric, sulfuric, or other appropriate acid will be employed.

In thus decorating glassware and other utensils or articles of manufacture a flexible transparent plate or film will be provided with a number of intersecting sets of parallel lines in the manner thus described, and this plate or film will then be used as a master-plate with which to print upon the utensil or article to be decorated. For example, in decorating a tumbler T, such as is shown in Fig. 5, a transparent film E, provided with the desired number of intersecting parallel rulings, will be wrapped around the tumbler after the surface of the latter has been properly

sensitized, and the tumbler will then be exposed to the light and afterward developed and etched, as above described. This will result in the transference to the tumbler of the same rulings present on the film E, and the diffraction of the light-rays by these rulings will give the desired decorative effect to the tumbler. Of course where the surfaces to be decorated are all plain surfaces a rigid glass plate may be employed as the medium through which the printing is accomplished; but ordinarily the flexible film will be more satisfactory, if not indispensable.

In case a master-plate larger than any grating which can be conveniently ruled on a dividing-engine is desired or in case it is wished to vary the pattern of the rulings on such master-plate a smaller plate may be used to print the crossed diffraction-gratings in successive spots all over the surface of the master-plate after the manner indicated in Fig. 6.

I claim as my invention—

1. The herein-described method of decorating surfaces for the purpose of producing colored-light effects, which consists in exposing a sensitized surface in a plurality of angularly-different positions under a transparent diffraction-grating, and then developing the exposed sensitized surface to fix the several intersecting sets of lines printed thereon, substantially as described.

2. The herein-described method of decorating surfaces for the purpose of producing colored-light effects, which consists in exposing a sensitized surface in a plurality of angularly-different positions under a transparent diffraction-grating, developing the exposed sensitized surface to fix the several intersecting sets of lines printed thereon, and then etching the printed lines into the surface, substantially as described.

3. The herein-described method of decorating surfaces for the purpose of producing colored-light effects, which consists in exposing a sensitized surface under a transparent crossed diffraction-grating, and developing and etching the printed lines, substantially as described.

4. As a new article of manufacture, glass, pottery, and metal ware, having its surface decorated with intersecting sets of closely-adjacent parallel lines forming diffraction-gratings, substantially as described.

5. The herein-described method of decorating surfaces for the purpose of producing colored-light effects, which consists in exposing a sensitized surface under a transparent crossed diffraction-grating, and developing the printed lines, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two subscribing witnesses, this 20th day of June, A. D. 1902.

ALBERT B. PORTER.

Witnesses:

HENRY W. CARTER,
K. A. COSTELLO.