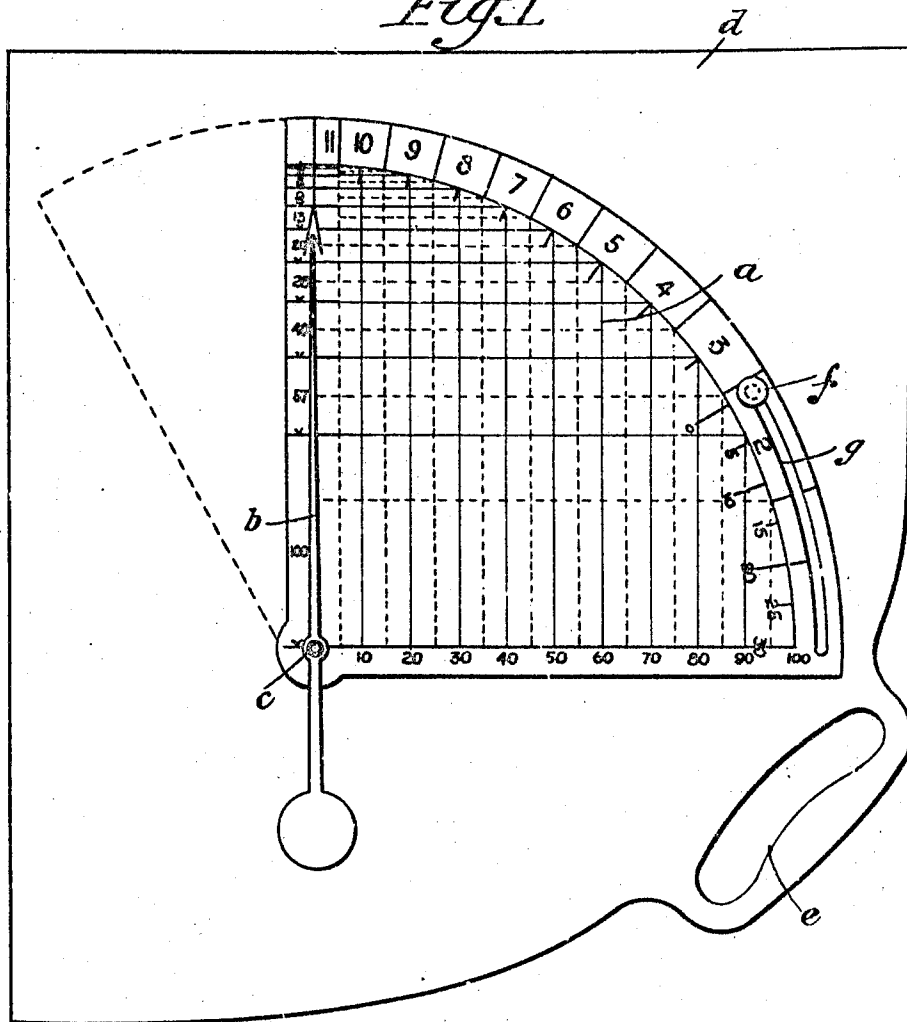


G. BRUSH.
SYSTEM FOR REDUCING THE VISIBILITY OF OBJECTS.
APPLICATION FILED JUNE 2, 1917.

1,296,753.

Patented Mar. 11, 1919.
2 SHEETS—SHEET 1.

Fig. 1



WITNESSES:
E. M. Mitchem

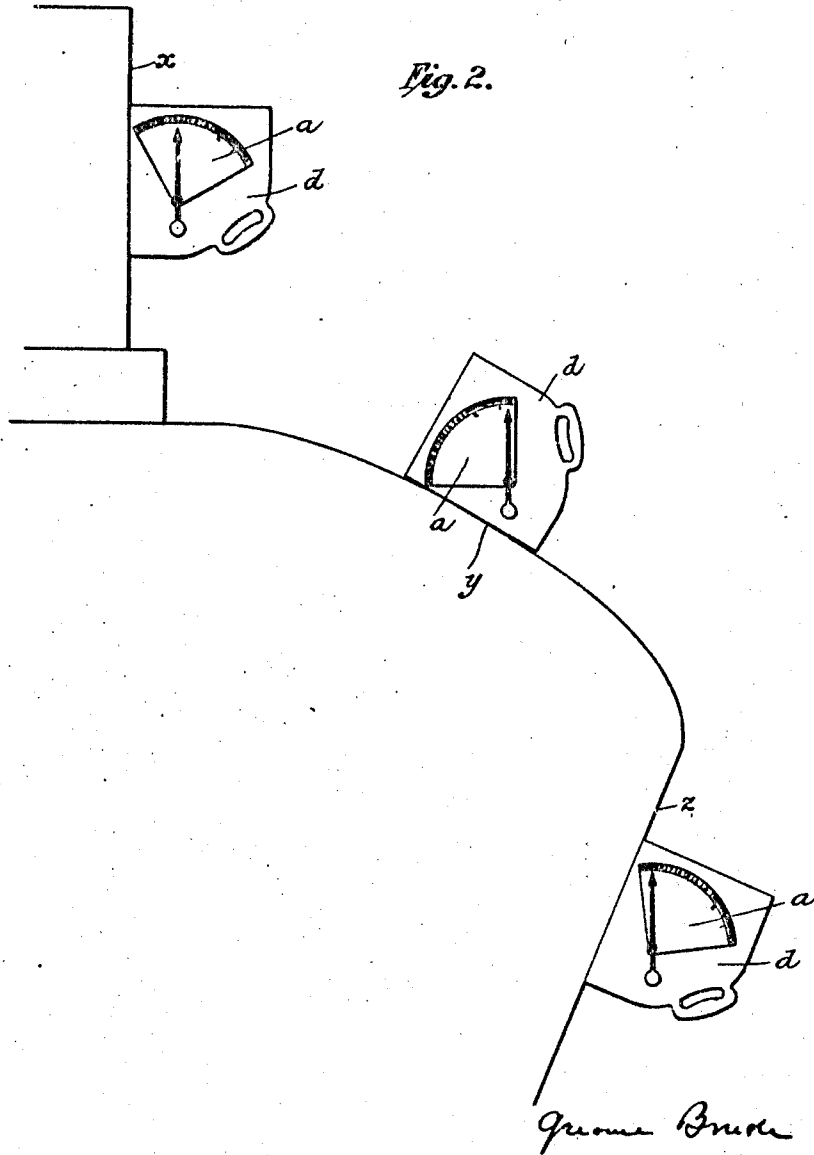
George Brush
INVENTOR.

BY *W. B. Whitney*
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WITNESS:
D. Michelson

George Brush

INVENTOR

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ATTORNEY

UNITED STATES PATENT OFFICE.

GEROME BRUSH, OF DUBLIN, NEW HAMPSHIRE.

SYSTEM FOR REDUCING THE VISIBILITY OF OBJECTS.

1,296,753.

Specification of Letters Patent.

Patented Mar. 11, 1919.

Application filed June 2, 1917. Serial No. 172,558.

To all whom it may concern:

Be it known that I, GEROME BRUSH, a citizen of the United States, residing at Dublin, in the county of Cheshire and State of New Hampshire, have invented a new and useful System for Reducing the Visibility of Objects, of which the following is a specification.

My present invention is in the nature of an improvement upon the process of treating the outsides of objects to make them less visible disclosed in Letters Patent No. 715,013, issued on December 2, 1902, to Abbott H. Thayer and myself, jointly.

The illuminating effect of light upon the different surfaces of an object varies substantially as the cosine of the angle of incidence, being maximum when such angle is zero—that is to say, when the surface illuminated is perpendicular to the rays of light—and becoming zero when the angle of incidence reaches a right angle; and I have discovered that the most effective blendings of colors to produce the shades with which to paint each of the different surfaces of the object, to secure its invisibility, is obtained by mixing together light and dark colors, white and black for example, in proportions substantially equal, respectively, to the sine and to the complement of the sine—the difference between the sine and the radius—of the angle of incidence of that surface. With the shades of color thus obtained for its various surfaces, graduated from dark to light substantially according to the illuminating effect of light thereon, I am able by preventing practically all contrasts of light and shade on an object to secure a nearly perfect monochrome.

I have also discovered that the same monochrome effect can be obtained, without a mixing of the colors, by painting the various surfaces of the object with alternate dark and light stripes or squares, or dark with regularly disposed light spots or vice versa, proportioning the dark area to the light area on each different surface substantially as the cosine of its angle of incidence.

In the practical application of my invention, I divide all surfaces within the quadrant into a plurality of divisions or zones representing, according to their angles of incidence, substantially equal gradations of illuminations, and determine the proper blendings of colors or shades of paint to be used, or the proportions of the areas to be

painted dark and light respectively, to give to the surfaces within each zone the desired color effect. Taking for example ten divisions or zones and ten gradations of color, a number which I consider ample for all purposes, I use the angles of cosine .95, cosine .85, cosine .75, etc., to define the boundaries of the several zones, and the angles cosine .90, cosine .80, cosine .70, etc., which angles indicate the centers of illumination of the respective zones, to determine the blending of colors for the paint therefor. Thus, the first zone, which is a half zone, extends from the zero angle of incidence to angle cosine .95, and all surfaces therein are painted black. The second zone, a full zone, extends from angle cosine .95 to angle cosine .85, and all surfaces therein are painted with a blend containing 57 (.57 being approximately the complement of the sine of angle cosine .90) parts of black to 43 parts of white. Surfaces within the third zone, bounded by angles cosine .85 and cosine .75, are painted with a blend containing 40 parts of black to 60 parts of white. For the surfaces within the fourth zone, bounded by the angles cosine .75 and cosine .65, a blend containing 28 parts of black to 72 parts of white is used. The surfaces within the fifth zone, between the angles cosine .65 and cosine .55, are painted with a blend containing 20 parts of black to 80 parts of white. For surfaces within the sixth zone, between angles cosine .55 and cosine .45, the paint contains 13 parts of black to 87 parts of white. For surfaces within the seventh zone, between angles cosine .45 and cosine .35, the paint used contains 5 parts of black to 95 parts of white. The surfaces within the eighth zone, extending from angle cosine .35 to angle cosine .25, are painted with a blend containing 2 parts of black to 98 parts of white. The paint for surfaces within the ninth zone, between angles cosine .25 and cosine .15, contains 1 part of black to 99 parts of white. Within the tenth zone, between the angles cosine .15 and cosine .05, the surfaces are painted with a blend containing 1 part of black to 99 parts of white. And surfaces within the eleventh zone, another half zone, extending from angle cosine .05 to an angle of 90 degrees, as well as all surfaces which are in shadow or have negative angles of incidence, are painted white.

When painted with alternate areas of black and white, instead of with a blend of

colors, all surfaces within the first zone, 90 per cent. of surfaces within the second zone, 80 per cent. of surfaces within the third zone, etc., are painted black and the remainder of the surfaces within each zone are painted white.

Where the object and the source of illumination are both fixed, the angle of incidence of each different surface of the object will, of course, be constant. But where either the source of illumination or the object or both are movable, the angle will be variable. For example, in the case of a ship illuminated by the sun, the angles of incidence upon its surfaces will depend upon the course and position of the ship and the time both of the day and of the year. In the latter cases, it is desirable to determine, somewhat arbitrarily but as definitely as possible, the average zero angle of incidence, which in the case of a ship, varying with the latitude and time of year, will be approximately 30 degrees from perpendicular and from such zero angle as a starting point to treat the different surfaces of the object so that they will present the color effects graduated in the manner above described.

The invention will be readily understood by reference to the accompanying drawings, in which Figure 1 illustrates a scale or instrument which I have devised for the use of painters in practising my new system, and Fig. 2 is an outline view of the outer surfaces of one side of a ship, taken on a transverse section, showing the application to such surfaces of the scale of Fig. 1 adjusted for use on the assumption that the average zero angle of incidence is 30 degrees from perpendicular.

As shown in Fig. 1, *a* is the scale proper, in the form of a quadrant, and *b* is a weighted pointer both of which are pivotally mounted at *c* upon a block *d*, also in the form of a quadrant, provided with a suitable handle *e*. The scale is adjustably held in position upon the block by means of a thumb-screw *f* which passes through an arcuate slot *g* in the scale, while the pointer is free to turn by gravity about its pivotal bearing. The radial divisions around the periphery of the scale, numbered 1 to 11, are the nine zones and two half zones into which the surfaces to be painted are divided; the cosines and sines of the boundary angles of these zones being respectively indicated by the dotted horizontal and vertical lines merely for the purpose of showing how such angles are determined. The numerals 100, 57, 40, etc., in column near the vertical edge of the scale, represent approximately the complements of the sines (shown by light vertical lines) of the angles at the centers of illumination of the zones, and consequently indicate the percentage of the dark color to be used in the mixing of the paint

with which to paint the surfaces within the respective zones. The numerals 100, 90, 80, etc., along the horizontal edge of the scale, represent the cosines (shown by light horizontal lines) of the angles at the centers of illumination of the respective zones, and indicate the percentage of the area of the surfaces therein which are to be painted dark where such surfaces are painted with alternate dark and light areas. The zones on the scale may, if desired, be painted with the shade indicated for each, in which case the painter has in using the scale only to match the colors indicated thereon.

In the painting of a ship, for example, the scale proper having first been adjusted upon the block to the average zero angle of incidence assumed to be 30 degrees from perpendicular, the edge of the block shown as vertical in Fig. 1 is placed first against one and then against another of the different surfaces or portions of the surfaces of the ship, as illustrated in Fig. 2, and the pointer, swinging upon its pivot, turns to the zone within which such surface or portion of surface is included and so indicates the proper color effect to be given thereto. Thus, when the scale is applied to a vertical surface *x* the pointer will indicate that such surface is within the sixth zone and the scale will show that it is to be painted with a blend of colors containing 13 per cent. of black, that is to say, 13 parts of black to 87 parts of white; or, when painted with alternate areas of black and white, that 50 per cent. of the surface is to be painted black and the remaining 50 per cent. is to be painted white. Applied to a surface such as indicated at *y*, approximately 30 degrees from horizontal, the needle points to the first (half) zone and the scale shows that such surface is to be painted black. And when applied to a surface such as *z*, the pointer will indicate that the surface lies within the ninth zone and, as the scale shows, is to be painted with a mixture containing only 2 per cent. of black and hence 98 per cent. of white, or that 20 per cent. of its area is to be painted black and the remainder white.

Substantially all of the surfaces of a ship will be found to be within three or four of the different zones; and, in practice, it has proven convenient to have a foreman or the head painter go over the ship with the scale, or after sufficient experience without needing to use a scale, and with chalk to outline the zones on its surfaces and to indicate in each the blend of colors to be used therein.

The terms "black" and "white" as herein used are to be understood as designating colors which are essentially dark and light, respectively.

Having explained the principle of my invention and described and illustrated what

I now consider to be the best means to be employed for carrying the invention into practical operation, what I claim as new, and desire to secure by Letters Patent, is—

5 1. The process of reducing the visibility of an object which consists in dividing the surfaces of the object into a plurality of zones and in giving to the surfaces within the different zones different color tones, the single
10 color tone of the surfaces within each zone being graduated from dark to light substantially according to the approximate average illuminating effect of light thereon.

2. The process of reducing the visibility
15 of an object which consists in dividing the surfaces of the object into a plurality of zones and in painting the surfaces within the different zones with different blends of dark and light colors so as to give the surfaces
20 within each zone a single color tone which is graduated from dark to light substantially according to the approximate average illuminating effect of light thereon.

3. The process of reducing the visibility of
25 an object which consists in painting surfaces having different angles of incidence different shades of color which are graduated from dark to light by mixing together dark and light colors proportioned the light
30 color to the sine and the dark color to the complement of the sine of the angle of incidence of the surface.

4. The process of reducing the visibility of an object which consists in dividing the
35 surfaces of the object into a plurality of zones representing substantially equal gradations of illumination based upon an approximate average zero angle of incidence, and giving to the surfaces within the different
40 zones different color effects graduated from dark to light substantially as the cosines of the angles of incidence at the centers of illumination of the respective zones.

5. The process of reducing the visibility
45 of an object which consists in painting the different surfaces of the object different shades of color graduated from dark to light by mixing together for each different surface dark and light colors proportioned the
50 dark to the light colors substantially as the complement of the sine of the determined average angle of incidence of that surface.

6. The process of reducing the visibility of an object which consists in dividing the
55 surfaces of the object into a plurality of zones representing according to an assumed average zero angle of incidence substantially

equal gradations of illumination and painting the surfaces within each different zone with a different shade of paint obtained by mixing together light and dark colors in proportions, respectively, substantially of the
60 sine to the complement of the sine of the angle of incidence at the center of illumination of the zone.

7. As a new article of manufacture, an
65 object the surfaces of which have been divided into a plurality of zones and the surfaces within different zones given different color tones, the single color tone given to the surfaces within each zone being graduated from dark to light substantially according to the approximate average illuminating effect of light thereon.
70

8. As a new article of manufacture, an object the surfaces of which have been divided into a plurality of zones and the surfaces within the different zones painted with different blends of dark and light colors so as to give the surfaces within each zone a single color tone which is graduated from
75 dark to light substantially according to the approximate average illuminating effect of light thereon.
80

9. As a new article of manufacture, an object the different surfaces of which are painted with different blends of color which are graduated from dark to light by mixing together dark and light colors proportioned substantially the light color to the sine and the dark color to the complement of the sine
85 of the angle of incidence of the surface.
90

10. As a new article of manufacture, an object the different surfaces of which are divided into a plurality of zones representing according to an approximate average zero
95 angle of incidence substantially equal gradations of illumination and the surfaces within the different zones so treated as to present different color effects graduated from dark to light substantially as the cosines of the
100 angles of incidence at the centers of illumination of the respective zones.

11. As a new article of manufacture, an object the surfaces of which are divided into a plurality of zones representing approximately equal gradations of illumination and the surfaces within the different zones are painted with a blend of light and dark colors proportioned the light to the dark substantially as the sines to the complements of the
105 sines of the angles of incidence at the centers of illumination of the respective zones.
110

GEROME BRUSH.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."