May 2, 1950 A. B. HURLEY 2,506,153

OPACIFICATION OF PAPER

Filed June 17, 1947

Fig. 1.

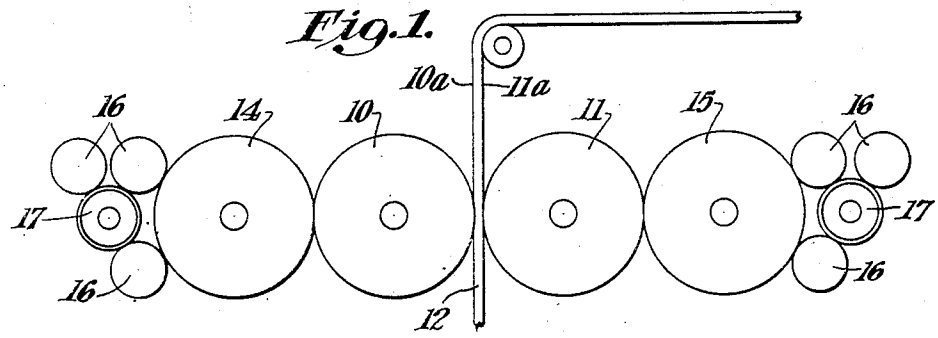


Fig. 2.

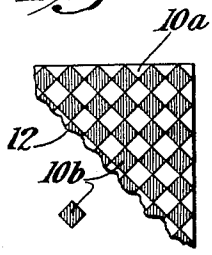


Fig. 3.

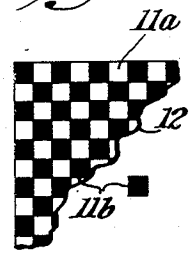


Fig. 4.

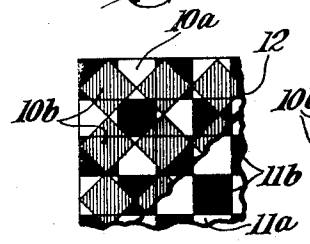


Fig. 5.

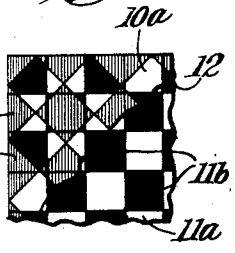


Fig. 6.

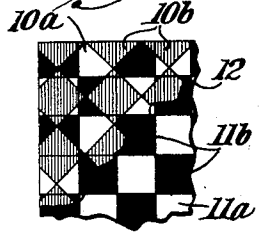


Fig. 7.

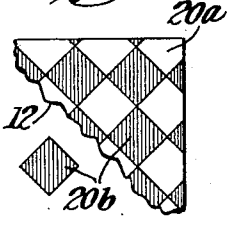


Fig. 8.

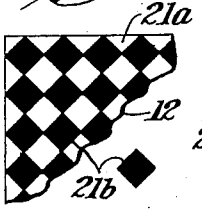


Fig. 9.

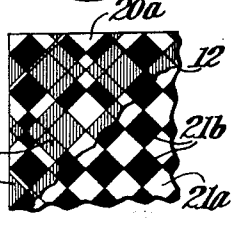


Fig. 10.

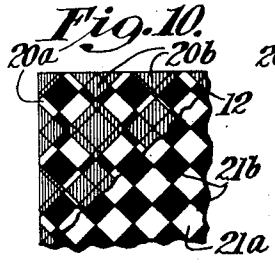


Fig. 11.

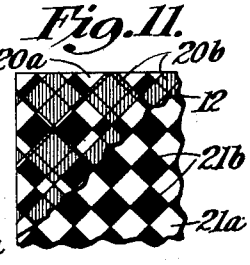


Fig. 12.

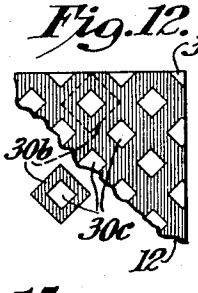


Fig. 13.

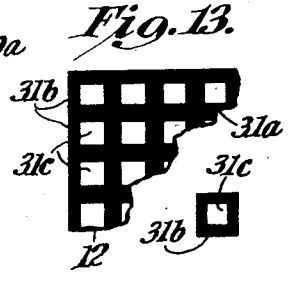


Fig. 14.

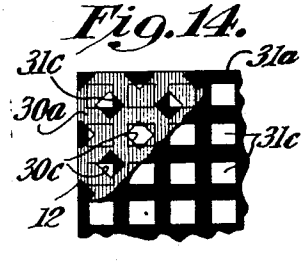
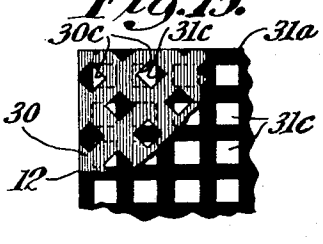


Fig. 15.



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BY
ATTORNEY

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UNITED STATES PATENT OFFICE

2,506,153

OPACIFICATION OF PAPER

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Application June 17, 1947, Serial No. 755,184

4 Claims. (Cl. 88—1)

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This invention relates to improvements in the method described and claimed in U. S. Letters Patent No. 1,877,512, granted to me September 13, 1932, and to the paper produced thereby as described and claimed in U. S. Letters Patent No. 1,969,707, granted to me August 7, 1934.

In the aforesaid Patent No. 1,877,512 I have described a method of treating the more or less translucent papers used by the printing industry in such manner as substantially to decrease the light transmission factor thereof. These papers including, of course, book or magazine, catalog, newsprint, etc. which because of their quality and/or thickness are not opaque. Those papers wherein bleached pulp is used during manufacture to obtain a certain desirable degree of whiteness have their transparency so increased by the use of such bleached pulp that a relatively thin and cheap newsprint may be less translucent than a thicker, more expensive, magazine paper. This transparency is extremely undesirable because of the "show through" from one printed side of the paper to the other when the paper is incorporated in magazines, newspapers, etc., or used for writing purposes.

In the aforesaid Patent No. 1,877,512 I have disclosed a method wherein a paper sheet or web of relatively cheap quality may be provided with grids at opposite sides, each screen or grid being of such fineness as to be imperceptible, as a grid, to the naked eye beyond a predetermined distance. So long as the elements or units of the grid at the aforesaid predetermined distance intercept or subtend visual angles equal to or less than three minutes of arc, the grid is sufficiently fine for this purpose. To the naked eye spaced from a treated sheet beyond the aforesaid distance, the design of the grid is imperceptible and the surface of the sheet or web appears to be continuous.

As I have disclosed in the aforesaid Patent No. 1,877,512 the grid material or pigment may be tinted in such manner that the grid functions as a filter screen whereby to absorb or filter the objectionable portions of the spectrum in such manner that, under artificial light, paper treated by this method will appear to be more nearly white than paper with an overall coating or finish of very high quality. Likewise, as I have also pointed out in that patent, the discontinuous nature of the coating provided by the grid reduces glare to a very large extent which is an important feature since it substantially reduces eye fatigue in artificial light.

According to the teachings of the above designated Patents Nos. 1,877,512 and 1,969,707, similar and similarly arranged grids or screens were applied to opposite sides of the paper. In those patents, I have illustrated grids of checkerboard design wherein the coated portions approximately equalled the uncoated portions between the treated portions i. e. the coverage achieved by each grid was approximately 50 per cent. Such grids may properly be termed 50/50 grids.

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In such cases, so far as opacity was concerned, the most desirable relationship of the grids at the opposite sides occurred where the coated portions of the grid at one side coincided with the uncoated portions of the grid at the opposite side. In such case, the ultimate increase of opacity of the treated paper sheet or web was achieved. However, because of slippage between the web or sheet and the offset or grid applying rolls, and because of the difficulty of achieving and maintaining perfect relative alignment of the rolls and the grids or screens applied thereby, the occurrences of such most desirable conditions was extremely rare. Also because of slippage between the rolls and the paper, the coverage varied even during one coating operation so that a paper of quite uneven quality was often obtained.

Thus according to the teachings of the above designated patents the increase in the opacity of the treated sheet or web varied between 50 per cent (50%) and 100 per cent (100%). According to this invention, as illustrated in the accompanying drawing, where a 50/50 grid is used at each side of the sheet or web the minimum opacity increase of 50 per cent (50%) is materially increased as will hereinafter appear.

According to this invention, the elements of the grids at one side of the treated sheet (or their major axes) are disposed at an acute angle with respect to the elements or units (or their major axes), of the grid at the opposite side of the sheet or web in such manner that where, as in the example illustrated in the aforesaid patents, the grids each provide 50 per cent (50%) coverage, a substantial increase in minimum coverage is achieved i. e. with a 50/50 checkerboard grid at opposite sides, as illustrated in Figs. 2–6, and with the elements or units of the grid (or their major axes) disposed at 45 degrees with respect to similar elements or units of the grid (or their major axes) at the opposite side of the sheet or web, the minimum coverage or opacity increase within a given area will equal or exceed 62½ per cent of the sheet area regardless of the relative alignment of the grids either longitudinally of the sheet or web, or transversely thereof. Since

the coverage percentage according to the practice of this invention may vary only between 62½ per cent and 100 per cent as compared with the range of 50 per cent to 100 per cent, the uniformity of the treated paper is substantially increased.

Likewise, by varying the fineness of the mesh or grid at opposite sides of the sheet or web as illustrated in Figs. 8 to 11 of the drawing, the minimum coverage may be materially increased. In such case, the coarsest web or grid or the grid on the side or sides of the paper which are to be observed should preferably be of such fineness, or mesh, that the units or elements thereof should subtend visual angles equal to or less than three minutes of arc at the desired predetermined distance from which the treated sheet or web shall be viewed in use.

While in Figs. 2–11 substantially 50/50 grids are used grids may vary from approximately 30/70 to approximately 70/30 or above; the higher the proportion of coverage in the grid, the higher the degree of opacity increase as may be seen by comparison of Figs. 12–15 of the accompanying drawing with Figs. 2–6, for instance.

Referring to the drawing, wherein I have diagrammatically illustrated certain preferred embodiments of my invention:

Fig. 1 is a fragmentary, diagrammatic view, illustrating the practice of my invention in an offset printing press of known form;

Fig. 2 is a fragmentary, enlarged view of one treated surface of the paper sheet or web of Fig. 1, as seen from the left of the upright portion of the sheet or web, looking toward the right in Fig. 1;

Fig. 3 is a view similar to Fig. 2 but showing the treated surface of the sheet or web opposite that shown in Fig. 2;

Fig. 4 is an enlarged fragmentary diagrammatic view illustrating the superposition of the grids on the opposite surfaces of the sheet or web as shown in Figs. 2 and 3 in one relative position thereof;

Fig. 5 is a view similar to Fig. 4 but showing the grids on the treated surfaces in a slightly different relative position;

Fig. 6 is a view similar to Figs. 4 and 5 but showing the grids of the treated surfaces in another relative position;

Fig. 7 is a view similar to Fig. 2 but showing one side of a sheet according to a different embodiment embodying a grid of coarser mesh;

Fig. 8 is a view of the opposite surface of the sheet bearing the grid of Fig. 7;

Fig. 9 is a view similar to Figs. 4, 5, and 6 but illustrating the superposition of the grids of Figs. 7 and 8 in one relative position;

Fig. 10 is a view similar to Fig. 9 but showing the grids in another relative position;

Fig. 11 is a view similar to Figs. 9 and 10 but showing the superposed grids in a third relative position;

Fig. 12 is a view similar to Figs. 2 and 7 but illustrating one treated surface of a third embodiment embodying a grid of the "flyscreen" type;

Fig. 13 is a view similar to Figs. 3 and 8 but illustrating a "flyscreen" type grid applied to the opposite side of the web shown in the embodiment of Fig. 12;

Fig. 14 is a view similar to Figs. 4, 5, 6, 9, 10, and 11 but showing the superposed relationship of the grids of the embodiment of Figs. 12 and 13 in one relative position; and

Fig. 15 is a view similar to Fig. 14 but showing

the superposed grids in another relative position.

Referring to the drawing in detail, the illustrative offset press illustrated in Fig. 1 comprises a pair of offset rolls 10 and 11, clothed with a suitable material such as rubber, for transferring to the web 12 passing therebetween impressions received from the etched plate rolls 14 and 15 respectively. These latter rolls are provided with coatings of the pigment or grid forming material which coatings are applied by pigment rolls 16 in cooperation with the distributing rolls 17. The rolls 16 and 17 form a part of the pigment supply system of the press. The entire pigment supply system is illustrated and described in each of my prior U. S. Letters Patent Nos. 1,877,512 granted September 13, 1932, and 1,969,707 granted August 7, 1934. As shown in those patents, and as illustrated in Fig. 1, the web 12 passes upwardly between the offset rolls 10 and 11 which transfer to the respective surfaces of the web the grids, screens, or impressions 10*a* and 11*a* respectively (Figs. 2–6).

The aforesaid Letters Patent Nos. 1,877,512 and 1,969,707 disclose the use of similar and similarly arranged grids on opposite surfaces of the web.

Because of the difficulties of securing perfect adjustment of the offset rolls and complete avoidance of slippage between the web and offset rolls, it is well-nigh impossible so to superpose the grids at opposite sides of the web that ultimate opacity can be secured by aligning the open spaces between the grid on one surface with the coated portions of the grid at the opposite surface of the paper web. In some cases, the grids will be so completely superposed or aligned that the opacity of the web or paper is improved only over substantially one-half of the surface where similar 50/50 grids of similar mesh are applied to opposite surfaces as taught in the aforesaid Letters Patent.

According to my present invention, I have achieved a substantial improvement over the teachings of the above enumerated patents by disposing the grids on opposite surfaces of the web in the manner illustrated in Figs. 2 to 6 and 12 to 15 whereby the axes of the greatest dimension of the elements forming the grid are disposed substantially at 45 degrees with respect to one another. Other angular relationships are permissible but the 45 degree relationship is illustrated and herein described for the sake of convenience.

By the use of this angular relationship and with the use of 50/50 grids, the improvement, as to opacity, of substantially more than 50% of the web or sheet area is insured.

I have also discovered that this increase in treated surface may be achieved, to an appreciable degree, by varying the fineness of the grids at opposite sides of the web as shown in Figs. 7 to 11 inclusive.

Therefore, with reference particularly to Figs. 2 to 6 inclusive, it will be seen that the grid applied to the web 12 by the offset roll 10 is indicated 10*a* while that applied by the offset roll 11 is designated 11*a*. The grid 10*a* is made up of a plurality of substantially square elements 10*b* arranged in series with their diagonals, or larger dimensions, disposed longitudinally of, and transversely of, the web or sheet 12 (Fig. 2). The grid applied by the offset roll 11 is designated 11*a* (Fig. 3) and is comprised of a plurality of elements 11*b*, similar to the above described elements 10*b*, likewise arranged in series but with their side edges disposed longitudinally of, and transversely of, the web 12. The relationship of the grids is diagrammatically shown

in Figs. 4, 5, and 6 wherein it will be noted that the grid 10*a* always overlies portions of the areas of the spaces between the elements 11*b* of the grid 11*a*. Thus the increase of opacity by reason of this relative arrangement of the grids at opposite sides is indicated by the black areas between the units 10*b* in Figs. 4–6. This must necessarily follow in all relative positions of the grids 10*a* and 11*a* since the transverse and longitudinal dimensions of the elements 10*b* are greater than the transverse and longitudinal dimensions of the elements 11*b*.

In the embodiment of Figs. 7, 8, 9, 10 and 11, the difference in fineness of the grids 20*a* and 21*a* insures that the component elements 20*b* and 21*b* shall be staggered whereby the elements 20*b* of the screen or grid 20*a* overlie portions of the untreated areas between the component elements 21*b* of the grid 21*a*.

In the embodiment illustrated in Figs. 12, 13, 14, and 15, the grid applied to the web 12 by the offset roll 10 is of "flyscreen" type and is designated 30*a* being formed by a series of abutting rectangular open-centered elements 30*b*. These elements 30*b* are arranged diagonally, with the diagonals of the open centers 30*c* thereof disposed longitudinally and transversely respectively with respect to the sheet or web 12 as shown in Fig. 12. The grid or screen applied to the web 12 by the offset roll 11 is designated 31*a* as shown in Fig. 13. This grid or web is formed of a plurality of abutting open-centered elements 31*b* similar to the above described elements 30*b* but arranged with their side edges, as well as those of the open centers 31*c*, disposed longitudinally and transversely with respect to the web 12.

As shown in Figs. 14 and 15, the grid 30*a* overlies a substantial portion of the uncoated areas of the hollow centers 31*c* in the grid 31*a* with consequent improvement of the opacity of those areas. Fig. 15 illustrates one relative position of the grids 30*a* and 31*a* wherein substantially a minimum of this improvement of the opacity is achieved. The relative angular relationship between the webs or grids 30*a* and 31*a* thus insures that the treated area of the web 12 shall vary substantially between that shown in Fig. 15 and that shown in Fig. 14. As will be understood, the area per unit of sheet area covered by the grids 30*a* and 31*a* exceeds 50 per cent (50%) and any increase in this percentage of sheet area coverage increases the entire opacity percentage of a sheet treated with such grids or screens.

I have found that for coating papers adapted to be viewed at distances upwards of 14 inches a grid of from 65 to 133 mesh per inch is satisfactory for the practice of this invention. Normal reading distances may be considered as distances approximating 14 inches.

I have also found that among the many various materials which are suitable for use as grid-forming materials a mixture containing titanium dioxide, casein, and glycerine (tinted if desired) is suitable, the proportions thereof varying according to the porosity and other properties of the paper to be treated and the permissible drying time. This mixture is water soluble and is relatively convenient and cheap to produce and because of its cheapness effects a substantial saving since for a representative cheap paper the grid or screen treatment will effect increase of opacity comparable with conventional "allover" finishing processes which increase the weight of the newsprint stock approximately 10 times as much as does the treatment according to my process. For instance, by applying, according to my process 80 pounds of grid-forming material per ton, I can achieve results equalling those of "allover" coating or finishing processes wherein the weight of the newsprint paper stock is increased approximately 800 pounds per ton.

As will be readily seen in Figs. 4, 5, and 6, the opaque portions of the sheet or web treated or processed according to my invention are represented by the sum of the black and shaded areas at the upper left hand corner portion of each of the fragments shown in Figs. 4, 5, and 6. The same is true in Figs. 9, 10 and 11 and in Figs. 14 and 15 of the drawing.

The grids represented by the black and shaded portions in these figures may be applied either before the application of other printings or lines such as in ledger paper, etc. or thereafter. Thus my process may be practiced either as a part of the paper making process in a paper mill or at any time thereafter as a paper treating or converting process independent of the paper making process.

The terms "sheet" and "web" are herein used in their broad sense i. e. interchangeably. Likewise the term "paper" should be broadly construed as comprehending papers of varying grades and compositions as well as other materials of like character including textiles, etc.

While I have illustrated the practice of my invention by the use of an offset printing press, it is, of course, to be understood that the grids or screens may be applied by direct printing processes and various other known processes, and that partial areas of the sheets or webs may be treated, if desired.

The use of various forms of grids or screens other than those illustrated is also contemplated, it being merely necessary that the fineness of the grid be such that at a desired predetermined distance the eye will not register separate units of light and shade, or be able to resolve the grid into its component parts. The component units of the various grids may comprise any circumscribed geometrical figures; for instance they may vary from a triangle to a circle, grids made up of squares such as 10*b*, 11*b*, 20*b*, 21*b*, 30*c* and 31*c* being herein illustrated simply for the sake of convenience.

The essential point is that the grids on opposite surfaces cannot be made to overlie each other completely (that is, be made congruent) by any straight line movement between them, such straight line movement being the only type that can take place during the coating of the web; in this way, the screens are bound to be partially non-overlapping in any relative position.

It is, of course, to be understood that the above description is merely illustrative and in nowise limiting, and that I comprehend within my invention such modifications as are included within the scope of the following claims.

Having, thus, fully described my invention, what I claim as new and desire to secure by U. S. Letters Patent is:

1. As a new article of manufacture, a substantially translucent paper sheet having on opposite surface area portions thereof open work grids, each grid comprising a plurality of elements of geometrical design of substantially uniform shape and size, each element when applied to and in combination with said paper being sub-

stantially opaque, said elements being arranged symmetrically in spaced relation in a uniform pattern with respect to an axis extending in a preselected direction, the distance separating adjacent elements being of substantially the same order as a distance across such an element, each element of each grid subtending a visual angle of less than about three minutes of arc at normal distances for viewing by the human eye, said grids being fixedly disposed on said directly opposite area portions of said sheet, such axes and patterns thereof being disposed at a preselected acute angle.

2. As a new article of manufacture, a substantially translucent sheet having formed on opposite surfaces thereof checkerboard grids comprising units arranged in spaced relationship symmetrically with respect to an axis extending in a preselected direction and in accordance with a uniform pattern, each unit in combination with said sheet being substantially opaque, said units and the spacing between adjacent units intercepting visual angles of less than approximately three minutes of arc at normal distances for viewing by the human eye, said grids each providing coverage of its respective surface of between about thirty and seventy percent, the grids being fixedly applied on such surfaces with such axis and pattern of one grid disposed at an acute angle relative to such axis and pattern of the other grid, the units of one grid overlying at least partially the spaces between the units of the other grid regardless of the position along its axis of one grid relative to the other.

3. As a new article of manufacture, a substantially translucent paper sheet having printed on portions at least of opposite sides thereof openwork grids comprising a plurality of elements of substantially uniform shape and size, each element in combination with said sheet being of substantially lower translucency than such sheet alone, each element and the space between adjacent elements of each grid intercepting a visual angle of less than about three minutes of arc each at normal distances for viewing by the human eye, and the elements of each

grid being arranged in a uniform pattern symmetrically with respect to an axis extending in a preselected direction, said grids being printed on said opposite surfaces with the patterns and such axes thereof disposed at a preselected acute angle, the grid covered portions on one surface overlying at least partially the uncovered portions on the other surface.

4. As a new article of manufacture, a substantially translucent paper sheet, said sheet having openwork grids fixedly applied on portions at least of the opposite surfaces thereof, each of said grids comprising a plurality of fine elements of substantially uniform size and shape arranged in spaced relationship in a uniform pattern symmetrically relative to an axis extending in a preselected direction, each element and each space between adjacent elements subtending a visual angle of not substantially greater than about three minutes of arc at normal distances for viewing, each element in combination with said paper being substantially opaque, and the grid pattern on one side of said sheet being disposed at an acute angle to the grid pattern on the opposite side of said sheet, the elements of one grid overlying the spaces between the elements of the other grid at least partially regardless of the position of one grid relative to the other along such axis.

ALBERT B. HURLEY.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
1,800,044	Baird	Apr. 7, 1931
1,877,512	Hurley	Sept. 13, 1932
1,969,707	Hurley	Aug. 7, 1934
2,396,391	Ross	Mar. 12, 1946
2,425,068	McIntosh	Aug. 5, 1947

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