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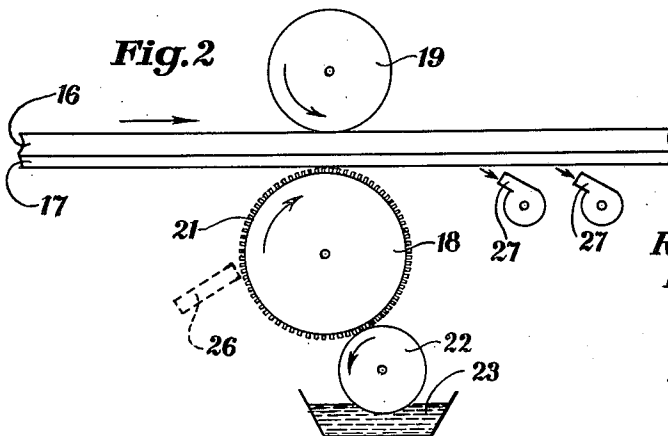
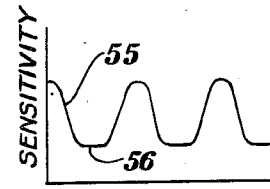
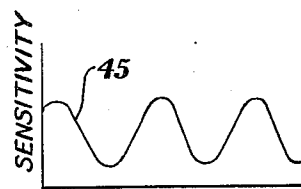
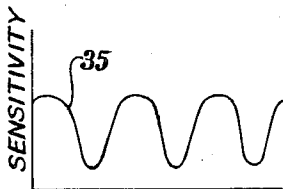
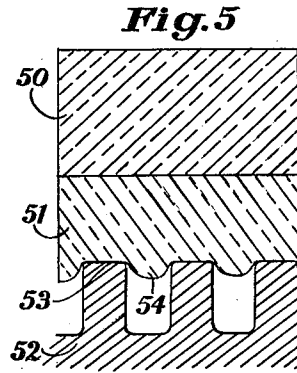
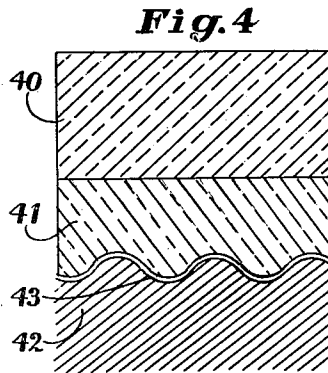
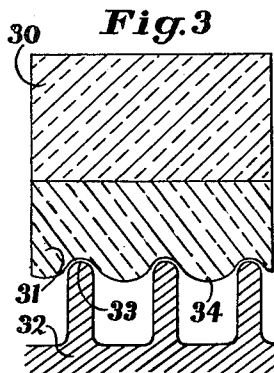
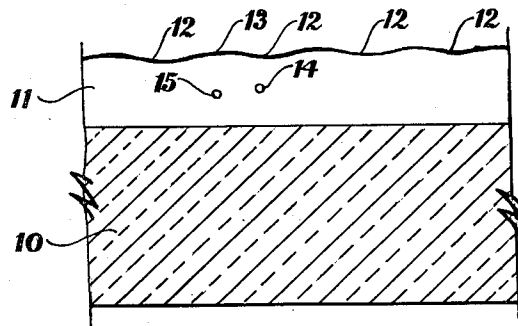
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PRESSURE PRESCREENED GRAPHIC ARTS FILM

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Fig. 1



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PRESSURE PRESCREENED GRAPHIC ARTS FILM

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2 Claims. (Cl. 95—8)

This invention relates to prescreened photosensitive material for use in the graphic arts. A prescreened material is one which, when exposed to a continuous tone image, forms a halftone record thereof without the use of a halftone screen.

The idea of prescreened films or plates has been investigated for two or three decades, but the cost of manufacture of such a material with good keeping qualities, good uniformity and adequate reproduction scale or range has restricted their commercial use. The objects of the present invention are to provide a prescreened film or plate which is easy to manufacture, uniform in sensitivity, with adequate keeping qualities under normal storage conditions and adequate scale for reproducing originals of normal contrast.

According to the invention a photographic halftone material such as film or plate is made up of a flat support and a photosensitive silver halide emulsion layer on the support with a halftone pattern of locally stressed dots. For most purposes it is desirable to have a film or plate with a maximum gamma greater than 4, i. e., one of the so-called "lith" films. However, films of somewhat lower gamma such as the process films and plates are also useful when prescreened according to the present invention. When an emulsion layer is compressed or at least pressed and then the pressure removed, the layer, of course, springs back toward its normal position so that the residual compression if any is not too apparent. Preferably the pressure is applied so that the degree of stress varies continuously across each dot from the centers to the corners.

The theory of what happens to the individual silver halide grains is not fully understood of course. However there are a number of features which can best be discussed with reference to some theory although it must be understood that the invention operates as described whether the theory is the correct one or not.

There are three types of stress (see any Mechanical Engineer's Handbook) namely tension, compression and shear. Tension refers to the case where the distance between molecules is increased, at least in one direction. Compression decreases the distance between molecules. Shear refers to a transverse or sliding movement of one molecule relative to another. Shear is almost always present when the other two occur. For example point pressure on a layer appears to compress the layer but (particularly if the layer is substantially incompressible) the squeezing of the molecules to the side is shear. With respect to the residual effect of these stresses a material subjected to tension is said to be stretched, one subject to compression is compressed but not all materials subject to shear become "sheared" which commonly means cut off. They are here referred to as shear stressed.

In the present invention, shear stress appears to be the important one; the effect, if any, of pure compression or pure tension is not easily provable, but it has been shown that their contribution is at best small compared to that due to shear. As a practical matter shear is always present during stress whether or not the other two are also present and therefore "shear stressed dots" emphasizes the important features and covers all practical embodiments of the invention.

A halftone pattern may, of course, take several different forms, and the terms such as "centers" and "corners" as used herein are intended to be generic to the corresponding parts in all forms of halftone patterns. The commonest form is a dot pattern and the term "centers"

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refers to the points of maximum sensitivity, i. e. the points which have received the least shear stress, and the term "corners" refers to the points of minimum sensitivity, i. e., the points which have received the maximum desensitization by pressure (shear stress).

Since a long range or scale of sensitivities across each dot is desirable, the preferable form of film or plate is one in which the dots have been stressed in the presence of moisture. After drying, the physical appearance of the film is not detectably different from that in which no excess moisture was present during stressing, but the product itself is actually quite different since the degree of desensitization is greatly enhanced. That is, the products are quite different, the difference being due to the fact that one is shear stressed dry and the other shear stressed in the presence of moisture.

The degree of desensitization is not a simple function of the moisture present since films conditioned to high relative humidity (say 70%) are not as susceptible to desensitizing by pressure as drier films, but this effect is overcome by the other effect just discussed in which moisture is applied at the time of (or just before) shear stressing. It is believed that the two effects act together if the pressure points are dry and the area between is moist. The latter improvement is relatively small and, whatever the theory involved, the main fact remains that shear stress in the presence of moisture is more effective than without the moisture.

Different types of silver halide emulsions are affected differently by shear stress. Some are desensitized as in the present invention, some are fogged and there is an occasional one which is actually sensitized slightly perhaps in the manner of a fog exposure below the threshold. The present invention employs any silver halide emulsion which is desensitized by shear stress or local pressure. Ever since films were first made and bent sharply or clipped with a paper clip, the ones having this property have been known. In fact various efforts have been made to reduce the susceptibility of films to this so called "kink desensitization." Films used for halftone work including the "lith" films have this well known property and any having it are useful in the present invention, and the greater the susceptibility to desensitizing by stress the better. As pointed out, many if not most emulsions are desensitized by stress. The present invention uses this hitherto objectionable property. If one does not desire the high contrast of a lith emulsion, desensitizing characteristics are also available with lower contrast emulsions such as numbers 8, 9, and 10 described on page 330 of the Photographic Journal, Volume 79, 1939 by A. P. H. Trivelli and W. F. Smith. However, the lith emulsions are the ones used in the preferred embodiments of the invention.

The halftone pattern is conveniently applied by either a flat or cylindrical printing plate having a hard surface with a halftone pattern of raised dots. The pressure applied by the tops of the dots desensitizes the corresponding area of the film forming the corner of the prescreened dot in the film. The use of printing rollers rather than flat plates permits the continuous prescreening of large rolls of film and of course requires less overall pressure since there is only "line" contact i. e. contact over a narrow area, with the printing roller at any one moment which gives high pressure per square inch. The moisture is applied to the printing plate before it contacts the silver halide emulsion layer. The water or other moisture may be carried either by the tops of the raised dots of the halftone pattern or there may be excess moisture so that even the recesses between the dots have moisture in them or the moisture may even be removed from the tops of the dots by a doctor blade or a wiper so that the water is only in the recesses when it reaches the film. To a first order appraisal, the results of these three systems are essentially equivalent. However the last mentioned one is the preferable one probably because the points receiving maximum pressure are dry (and hence most susceptible to shear desensitization) and the areas between the pressure points are wet to allow more shear even under the pressure points and, at the same time, if there is any reduction in the susceptibility to shear desensitization due to the moisture, it is in the areas where less desensitiz-

ing is desired. Whether or not any of the moisture reaches the emulsion directly under the pressure points, the shear effect is apparently greater when the surrounding emulsion is wet and hence does not hold the "dry" center so firmly. Also the distribution of the water is maintained more uniform when confined to the areas between the pressure points. Again it is pointed out that the invention is independent of the preciseness of these theories but they do seem to explain the observed effects.

The effects of different shapes of printing dots are discussed below, and are apparent only in the shape of the sensitivity distribution curve across the individual dots. A small additional effect is obtained when the tops of the printing dots carry a chemical desensitizing agent. The use of desensitizers alone was proposed many years ago. In the present case the combination with chemical desensitization adds only a minor amount to the exposure scale. The speed at which the film passes between the pressure rollers is not critical except that in the preferred embodiment using moisture applied by the printing roller itself it theoretically cannot be so fast that the moisture has no effect. Normal printing speeds provide adequate time however. It is well known that water soaks into gelatin extremely rapidly. That is, the moisture must be present in at least the surface of the layer not just in the vicinity in order to get the enhanced effect just discussed.

The degree of pressure required is not too critical and of course depends on the hardness of the emulsion layer. Ten pounds pressure on a small printing roller 6" wide 4" diameter with line contact on the film gives a useful result but there is no harm in using 10 or perhaps 20 times this much pressure. There must be enough pressure to appreciably desensitize the corners of the prescreened dots and preferably not enough to desensitize the centers of the dots very much. Whatever the shape of the printing plate dot, the effect of the pressure spreads from the so-called corner to the center and eventually reaches the center if the pressure is great enough. In practice a very wide range of pressures has been found to be satisfactory although the response curve changes somewhat. Excessively and extremely high pressures appear to have no adverse effect. Thus there is practically no upper limit on pressure to be used but there is no point in going to such high pressures.

The operation of the invention will be more fully understood from the following description when read in connection with the accompanying drawing in which:

Fig. 1 is a greatly enlarged section of a prescreened material according to the present invention;

Fig. 2 schematically illustrates the preferred method of manufacturing such material;

Figs. 3, 4 and 5 schematically illustrate the effects of different forms of pressure plates;

Figs. 6, 7 and 8 show the sensitivity curves corresponding to the manufacturing processes illustrated in Figs. 3, 4 and 5 respectively.

In Fig. 1 a support 10 of film or glass carries a silver halide emulsion layer 11 desensitizable by stress and having a halftone pattern of shear stressed dots 12. The areas 13 of the emulsion layer 11 are not shear stressed and have the maximum sensitivity so that they constitute the centers of the prescreened dots and the shear stressed areas 12 constitute the corners of the dots. In Fig. 1 the top surface of the emulsion layer 11 is shown very slightly undulating. In some embodiments of the invention these residual undulations are actually detectable when illuminated at grazing incidence and viewed with sufficient magnification, but the invention is operative whether there is any detectable residual compression or not. The shear stressed dots are in the valleys and the centers 13 are the hills of these undulations. The silver grains such as 14 are shear stressed and those such as 15 are stressed less or not at all. These grains differ greatly in sensitivity.

In Fig. 2 a film 16 carrying a sensitive silver halide emulsion layer 17 is passed between a printing roller 18 and a back pressure roller 19. The surface of the printing roller 18 is a hard surface with a halftone pattern of raised dots represented at 21. The direction of motion of the film and of rotation of the rollers 18 and 19 is indicated by arrows. A dampening roller 22 picks up water from the reservoir 23 and applies it to the surface 21. This water may be applied only to the tops of the printing plate dots in the same manner as ink is applied in letter press printing or an excess may be applied so that there

is moisture both on the tops of the dots and in the recesses between the dots of the printing plate. This form could eliminate transfer roller 22 and have the printing roller 18 dip directly into a bath of water such as 23. Alternatively the moisture may be thus applied in excess and then removed from the tops of the printing plate dots by a squeegee or wiper 26. The advantages of the latter arrangement are discussed above. In all cases, moisture is present at the time pressure is applied by the printing roller 18 to the emulsion layer 17. Any residual moisture carried by the film is removed by driers 27. Similar but less efficient results are obtained when the moisture is applied by a separate roller or bath to the emulsion layer 17 before it reaches the printing roller 18, but the arrangement shown in Fig. 2 is preferable.

Figs. 3 to 8 illustrate the effects of different types of printing plates. The particular form of printing plate is not critical to the present invention and any of the forms shown or any obvious modification thereof gives useful results.

The simplest form is that shown in Fig. 3 in which a film 30, carrying an emulsion layer 31 is pressed by a printing plate 32 having relatively small dots with rounded tops 33. Only the top of each dot comes in contact with the emulsion and the desensitizing of the areas 34 of the emulsion layer 31 is only that due to the distribution of the shear stress in the gelatin emulsion layer 31. This distribution depends on the hardness and thickness of the emulsion, i. e., on whether the film is of a lith or process type, and also on the resilience of the base as might be expected since these factors directly affect the shear. However, the result in general is a sensitivity distribution such as represented by a curve 35 in Fig. 6 in which the points of maximum sensitivity are relatively broad and the points of minimum sensitivity are relatively narrow. The shape of this curve 35 changes somewhat with change in pressure between the plate 32 and the emulsion layer 31. A printing plate with more lines per inch gives a more symmetrical dot sensitivity than that shown since the width of the high sensitivity areas is made narrower.

It is desirable to reduce the sensitivity of the process to changes in pressure and one of the advantages of the arrangement shown in Fig. 4 is that any changes in the degree of pressure above some minimum value have less effect on the shape of the resultant sensitivity curve. In Fig. 4 the film 40 and the emulsion layer 41 come in contact with an undulating printing plate 42 whose surface carries dimples 43. In all cases the present process is useful in providing prescreened material which is relatively coarse, say 50 lines per inch, and also the finer screens such as 120, 133 and 150 lines per inch. The sensitivity curve shown at 45 in Fig. 7 is the form desirable for most photomechanical reproduction work.

Fig. 5 illustrate the effect of a printing plate with a uniform dot pattern somewhat larger than a highlight dot, but not up to a middle tone in which the printing plate has a complete checker board pattern. In Fig. 5 the film 50 carrying an emulsion layer 51 is in contact with a printing plate 52 whose dots 53 have an extended flat area. The emulsion in contact with the tops of the dots 53 receives uniform compression but the resultant shear stress is redistributed within the emulsion layer 51 itself. The areas 54 between the dots are affected in proportion to the distance from the edges of the printing plate dots 53. The resultant sensitivity is shown by curve 55 in Fig. 8 in which the points of minimum sensitivity have a slightly extended flat area 56 which in some cases may even have a slightly upward hump in the middle, probably because the greatest shear stress occurs a short distance in from the edges. Also these flat areas 56 are not quite as wide as the tops 53 of the printing plate dots since the effect of the dots falls off slightly toward the edges. All such slight variations in sensitivity distribution are considered second-order effects and in all cases the degree of shear stress and hence the sensitivity varies substantially continuously across each dot from the center to the corners. In no case is there a sharp break in sensitivity distribution; the halftone pattern is a uniformly distributed undulating pattern.

Having thus described the preferred embodiments of our invention, we wish to point out that it is not limited thereto but is of the scope of the appended claims.

We claim:

1. The method of prescreening a photosensitive sheet having a flat silver halide emulsion layer on a flat sup-

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port, which comprises desensitizing a halftone pattern in the flat emulsion layer by pressing against it in the presence of water a hard surface with a halftone pattern of raised dots with a pressure between that obtained with line contact on the layer from 10 pounds pressure on a small printing roller 6 inches wide and 4 inches in diameter and 10 times this much pressure.

2. A photographic halftone material made according to the process of claim 1.

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