June 6, 1950 W. M. BUSKES 2,510,863

EXPOSING APPARATUS FOR THE MAKING OF PHOTOGRAPHS, PHOTOPRINTS, NEGATIVES, AND THE LIKE

Filed Oct. 9, 1946

Fig. 1.

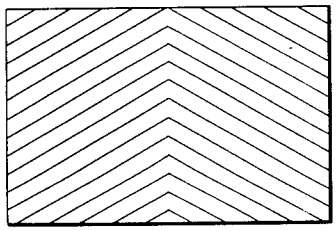


Fig. 2.

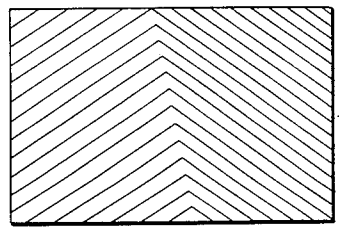


Fig. 3.

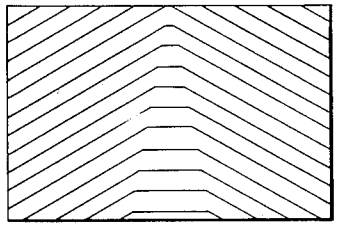


Fig. 4.

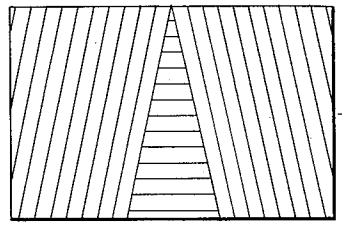
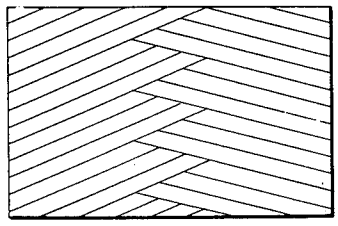


Fig. 5.



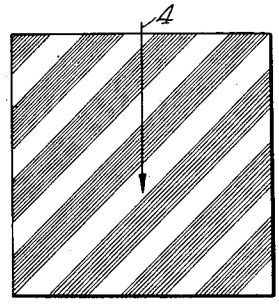
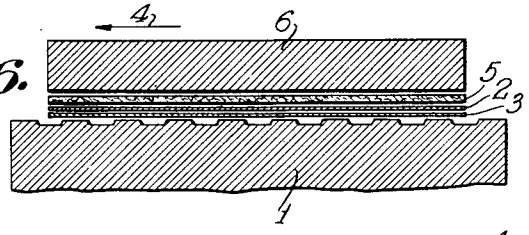


Fig. 7.

Fig. 6.



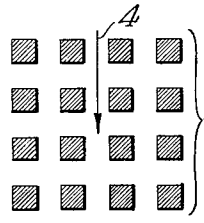


Fig. 8.

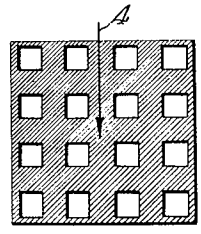


Fig. 9.

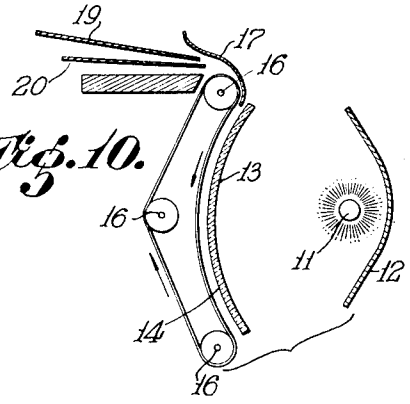


Fig. 10.

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EXPOSING APPARATUS FOR THE MAKING OF PHOTOGRAPHS, PHOTOPRINTS, NEGATIVES, AND THE LIKE

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In the Netherlands October 11, 1945

8 Claims. (Cl. 95—75)

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This invention relates to improvements in exposing-apparatus for the making of photographs, photo-prints, negatives and other photo-prints.

In the normal contact printing from transparent originals, including negatives, positives, drawings, letters, on sensitized sheets and also in the production of reflex-copies or screen reflex-copies by means of sheet like materials, exposing-apparatus are commonly used, in which the material to be exposed (i. e. the original in contact with sensitized sheet), is moved in relation to the luminous source.

The most common form of apparatus are those having a curved unperforated or solid panel, over the outer wall of which is moved an endless conveyor cloth. The material to be exposed is placed between the conveyor cloth and the panel and is caused to slide over the surface of the panel, on the other side of which are one or more sources of light.

With this type of apparatus it sometimes happens that at any rate, part of the material to be exposed and which is moved over the panel (which, in normal contact printing is the original: in reflectography, the sensitized, possibly screened sheet or the separate sheet-like screen) adheres to the panel, while the sensitized paper or original in contact with the conveyor cloth is moved forward. This "sticking" (i. e. the exposed material is "checked" or "impeded," it sticks fast, thus it lags or is retarded) will sometimes last for some time but even when it is of short duration (only a second) the two layers, due to the speed of the exposure-apparatus, will have shifted several centimeters relatively to each other, so that a true contact-copy is out of the question.

This "sticking" which tends to occur particularly with films that have a smooth or glossy surface can, in dry atmosphere, probably be attributed to frictional electricity; in moist atmosphere it occurs mostly at the beginning of work, or when the surface in contact with the panel is itself moist. This is the case when a diazotype-print on film (e. g. superficially saponified cellulose-esterfilm) is developed by means of a thin film of a liquid developer and shortly thereafter serves as original for further copying by the normal contact-printing method.

To overcome this sticking, special exposure apparatus have been proposed comprising either a rotatable glass cylinder or an extra transparent belt in addition to and movable with the conveyor cloth. These apparatus are not only complicated, but have other objections. Thus

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with the combined transparent belt and conveyor cloth in which the transparent belt is not endless, the work only can be continued for a limited time. Thereafter the device has to be readjusted before it can be restarted. Likewise with co-rotating glass cylinders of larger dimensions, there is the objection, that they nearly always contain one or more bubbles, which upon each revolution are reproduced on the sensitized material.

In practice therefore, the earlier type of panel apparatus first described has been retained and although attempts have been made to overcome sticking and other difficulties by replacing the panel by a perforated plate, this has not been applied in practice.

This invention is concerned with exposure-apparatus of the earlier type, having an unperforated or solid glass or other light permeable panel, and conveying-devices for conveying the material to be exposed, which is made up of at least two layers (an original and the sensitized sheet) that move over the panel in contact with one another. According to the invention, the operative surface of the panel over which the material moves, is uneven and possesses projections and depressions over its whole working area in such number and of such form, that the chance of sticking is reduced, if not eliminated when a smooth surfaced film of a size of the operative surface is moved over it. The projections may take the form of ridges, ribs or suchlike.

With certain uneven structures, however, another type of relative displacement between the layers of the material to be exposed is liable to occur and this displacement will henceforth be termed "shifting." Whereas "sticking" occurs oftener with a smooth than an uneven surfaced panel and mainly with "smooth" films only and when it does occur, mostly causes an appreciable displacement between the layers or at least displacement over a relatively great distance, which varies with every exposure, the displacement due to "shifting" only occurs for a certain type of uneven panel and shows up both with smooth and other films or materials. While this displacement is practically always the same it does not occur at all with a smooth wall. "Sticking" and "shifting" are therefore different phenomena. On a closer examination of the "shifting" the following appeared i. e.:

The relative displacement due to "shifting" is directly proportional to the distance through which the material to be exposed is moved over

the surface. It is more or less dependent on the pressure exerted by the conveyor cloth or other device on the uneven panel and on the thickness and stiffness of the material to be exposed. These factors are not however of paramount importance in practice.

The most important consideration in addition to the distance through which the material is moved is the average space between the high spots of the surface of the panel, which in carrying out the invention is by preference made small, and by choice such that the mutual "shifting" of the layers of the material to be exposed, that occurs during movement over the panel, amounts, in the course of a single stretch of exposure to less than 0.03 mm. (for ordinary photo-prints still just admissible). Where the elevations consist of parallel crests and troughs, then it appears that their direction in relation to the direction of movement has an effect on the "shifting" so that this factor should be taken into account.

The uneven surface on the wall of the panel may be obtained by small particles of a substance that hardens or by attaching strips or other pieces of suitable material to it; it however is preferred to have the elevations incorporated in the material of the panel. These so-called uneven surfaces especially in conditions of considerable moisture show a considerable diminution of "sticking" in comparison with the normal (smooth) surface. Practically no "shifting" will occur where a glass panel is brought into a condition of dullness by rubbing it with an emery powder or by means of sand blasting and then polishing off the tops of the "elevations" so formed in the surface, such as with colcothar or by melting or grinding. It goes without saying, that the latter process must not be carried out to such an extent that a smooth or nearly smooth surface is again obtained. Tests have shown that a reasonable rounding off of the elevations has a desirable effect.

A glass surface over which the elevations are regularly distributed may for instance be obtained by covering the spots that must remain as "elevations" and by deep etching the remainder of the surface. This method is not only suitable for coarse, but for fine structures, e. g. as fine as that of the screens used in the technique of printing and in screen reflectography.

Good results can be secured with panes of fine cathedral glass, finely figured glass, finely ribbed glass, crystal glass, engraved glass, ornamental glass and similar kinds of glass with an uneven surface, many kinds of which are available in commerce.

The structure should by preference be such that the quantity of light passing to the material to be exposed (estimated for the full length or stretch of exposure) does not vary appreciably in directions transverse to the direction of movement. When using ribbed glass, the direction of the ribs should therefore not be selected to coincide with the direction of movement.

From tests with regularly spaced elevations some further rough lines of conduct could be obtained.

The diminution in the chances of sticking, especially when considering conditions of extreme moisture, which this invention has rendered possible, for those film-materials that are most liable to stagnate in practice under such conditions, and which must move along the wall pervious to light, is little dependent on the degree of coarseness or fineness of the structure, although for other reasons finer structures are to be preferred. It is obvious that the fining down of the structure cannot be continued ad infinitum, since a smooth surface would once again result. An experimental surface with distances of 25 mu between the crests or elevated portions of the structure has yielded excellent results.

Tests further show that in general it is desirable for the ratio between the mean heights of the crests or elevations and the intervals separating adjacent crests to be greater than 0.1.

Moreover it is advantageous to so dimension the relative areas occupied respectively by the crests and hollows that the former do not cover more than half the total surface of the panel. In many cases this also results in the surface being easier to make. Technical feasibility coupled with technical requirements (e. g. a reasonable resistance to wear and tear) create certain limits. Furthermore very sharp peaks to the elevations could have an effect comparable to that of a steel wire brush and thereby increase the chance of sticking.

The invention may be applied to any type of exposure-apparatus having an element slidable or otherwise movable across a curved surface pervious to light and includes also apparatus with plane panels, and those with curved panels of a special form, cf. British Specification No. 187,008. An additional advantage, which in many cases is obtained, is that the apparatus according to the invention shows less general friction and hence the chance of the material when traversing the apparatus during exposure being creased, is lessened. This may still further be diminished by using a ribbed surface with ribs transverse to the line of movement so that it has a stretching influence on the material to be copied.

The invention is illustrated in the accompanying drawings, in which Figs. 1 to 5 are diagrammatic plan views of various types of glass surfaces prepared according to the invention.

Fig. 6 is a sectional view showing an exposure apparatus with material to be exposed in position.

Figs. 7, 8 and 9 are part plan views of alternative types of surfaces.

Fig. 10 is a vertical section of the main part of an exposure machine, illustrated somewhat diagrammatically.

The light source (a mercury vapour tube) is indicated in Fig. 10 by **11**. It is located before the reflector **12**. The light pervious panel **13** especially is made according to the invention, having numerous depressions and smooth top projections on its surface in the whole area with which the material to be exposed will come in contact. The light emitting surface of the panel **13** is indicated by **14**. Along this surface **14** the material to be exposed is moved by means of the conveyor cloth **15**, guided and tensioned by three rollers **16**, one of which is driven.

The material to be exposed consists of a layer **19** and a layer **20**. In normal contact printing the layer **19** is a transparent original and the layer **20** the light sensitive material. In normal reflex copying processes the layer **19** is the light sensitive material and the layer **20** the original.

The material to be exposed is laid down on the table **18** and moved on to the surface **14** by means of the guiding member **17**.

Referring now to Figs. 1 to 5, the ribs consti-

tuting the crests of the uneven surface are shown by the full lines.

In the arrangement of Fig. 1 the ribs extend diagonally from the central zone of the panel in a direction to the sides thereof so that the angles formed in the central zone are directed like wedges against the direction of movement of the conveyor cloth (Fig. 1). Thus the central zone, where it has a perviousness to light differing noticeably from the rest, will, by preference, be more or less diagonal to the line of transport (Figs. 2–5).

It will be understood that in place of continuous ribbing, as shown in Figs. 1–5, also interrupted ribs, i. e. crests and troughs giving a serrated effect, may be employed.

Fine structure surface with a uniform perviousness to light enable the invention to be applied to automatic apparatus, in which the conveyor cloth carries the material to be copied to a zone where the whole of it is exposed, where it is held stationary till the exposure is complete and then removes it from the exposure-zone (cf. The British Journal of Photography dated 18th August 1939, page XII. This adaptation of the invention has particular advantages, because with intermittenlty operating apparatus, the chance of sticking is considerable, in consequence of the speed of operation and repeated acceleration of the material.

The light pervious panel and the ribbing or other uneven surface thereon may, of course, be made of any suitable material, e. g. glass or high molecular glass like substances. It is desirable for the surface unevennesses to be of tough and/or hard materials so as to eliminate wear and tear. Glass, and for special purposes, quartz, are particularly suitable.

To obtain the most satisfactory effects as regards light saving it is, of course, desirable for all parts of the surface to be pervious to light and that the elevated portions thereof set up as little dispersion of light as possible either by refraction or reflection.

Referring now to Fig. 6, **1** indicates part of the panel underneath which is a source of light not shown having a ribbed surface and over which the material to be exposed comprising a transparency **3**, a sheet of sensitized paper **2**, a felt backing **5** and a weight **6**, is moved. The material moves across the panel at a rate of 2 cm. per sec. over a distance of 62½ cm., in the direction of arrow **4**. The necessary pressure is obtained by the felt **5** and weight **6** of 20 grams per cm.^{2} (normal pressure in making photoprints). The crests and troughs are 0.5 mm. wide (these measurements also apply to the corresponding parts in Figs. 7–9). When the transparency **3** consists of a film, then because of the ribbed surface less sticking will occur in damp weather than with a smooth panel. Where the transparency **3** is on ordinary transparent paper of 80 gr. per M^2, practically no sticking will ever occur, but always a "shifting" of about 0.2 mm., which shifting, if the drawing is not too detailed, is not troublesome. When the same test is applied to Fig. 7 there is the same amount of "sticking" but less "shifting." A panel according to Fig. 8 very rarely causes sticking, but the same amount of "shifting" occurs as in Fig. 6. A panel according to Fig. 9 gives more sticking but less "shifting." In Figs. 7–9, the shaded portions represent the crests or elevations. In practice, structures are by preference selected, in which the distances separating the high spots of the

elevations are smaller than 0.5 mm., so that shifting becomes smaller, which is desirable for finer photo-prints.

By selecting a ribbed panel with troughs less than 0.5 mm., in width (the crests also are then made narrower which has appeared to be favourable to avoid sticking), the shifting decreases and for the given distance of 62½ cm. (lengths of this order are normal ones in present exposing-apparatus) it becomes imperceptible even for the finest photo-prints, when the troughs are 0.05 mm. and less wide.

In the construction of Fig. 6 the angle between the direction of movement and that of the ribs is 90°. In Fig. 7 it is 45°. With a distance between the ribs of 0.5 mm. and a movement of 62½ cm. and where the angle is e. g. 10°, the shifting is almost imperceptible.

What I claim is:

1. An exposure apparatus for photographing, photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area depressions and smooth top projections, of a maximum width of 0.5 mm., whereby during use any tendency of the material to stick when in contact therewith is substantially prevented.

2. An exposure apparatus for photographing, photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area depressions and smooth top projections, in which the ratio between the height of the projections and the distance separating adjacent projections is greater than 0.1, the depressions and projections being of a maximum width of 0.5 mm., whereby during use any tendency of the material to stick when in contact with the said surface is substantially prevented.

3. An exposure apparatus for photographing, photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area depressions and smooth top projections in which the area occupied by the tops of the projections is less than one-half the total surface of the panel, the depressions and projections being of a maximum width of 0.5 mm., whereby during use any tendency of the material to stick when in contact with the said surface is substantially prevented.

4. An exposure apparatus for photographing, photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area depressions and smooth top projections in which the ratio between the height of the projections and the distance separating adjacent pro-

jections is greater than 0.1 and the area occupied by the tops of the projections is less than one-half the total surface of the panel, the depressions and projections being of a maximum width of 0.5 mm., whereby during use any tendency of the material to stick when in contact with the said surface is substantially prevented.

5. An exposure apparatus for photographing, photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area depressions and smooth top projections of fine structure providing uniform perviousness to light over its entire effective area, the tops of the projections and the distances therebetween being not more than 0.5 mm. whereby during use any tendency of the material to stick when in contact with said surface is substantially prevented and uniform exposure is obtained.

6. An exposure apparatus for photographing, photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area depressions and smooth top projections in the form of ribs running transverse to the direction of the movement of the material to be exposed, the ribs and troughs therebetween being not more than 0.5 mm. wide, whereby during use any tendency of the material to stick when in contact therewith is substantially prevented and uniform exposure of the material upon completion of its movement over the panel is obtained.

7. An exposure apparatus for photographing,

photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area depressions and smooth top projections in the form of ribs, the depressions not being more than 0.5 mm. wide and the ribs being narrower than the depressions.

8. An exposure apparatus for photographing, photoprinting and other reproduction work comprising in combination a solid stationary panel of a light-pervious substance adapted to transmit light from a light source to the material to be exposed and means for moving said material in contact with and against the surface of said panel, said surface having over its whole working area a series of ribs which diverge in the direction of the movement of the material from a zone substantially in the middle of the panel as measured from the sides thereof, the ratio between the height of the ribs and the distance separating adjacent ribs being greater than 0.1 and both the ribs and the troughs therebetween being not greater than 0.5 mm. wide.

WILLEM MARIE BUSKES.

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