Jan. 8, 1946. R. S. POTTER 2,392,502

APPARATUS FOR MAKING PHOTOGRAPHIC PRINTS ON VARIABLE CONTRAST LIGHT-SENSITIVE MATERIAL

Filed June 8, 1944 2 Sheets-Sheet 1

Fig. 1

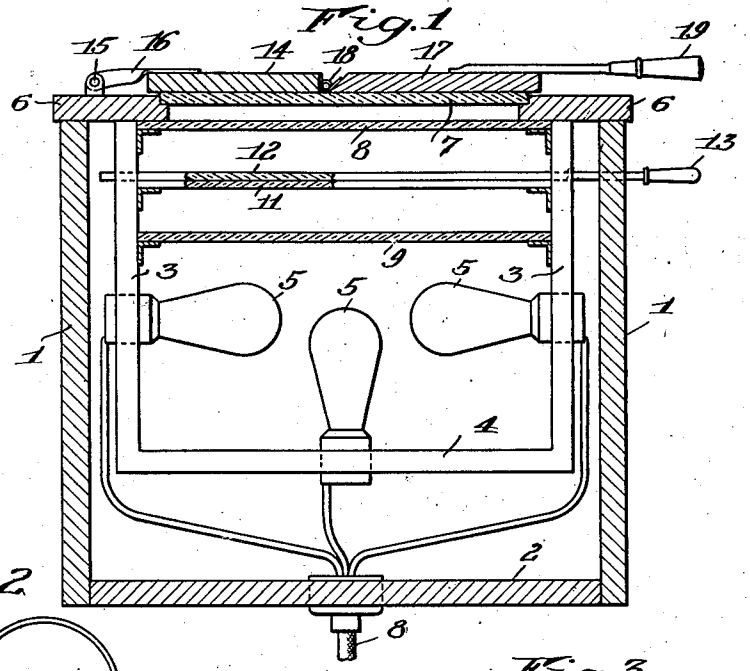


Fig. 2

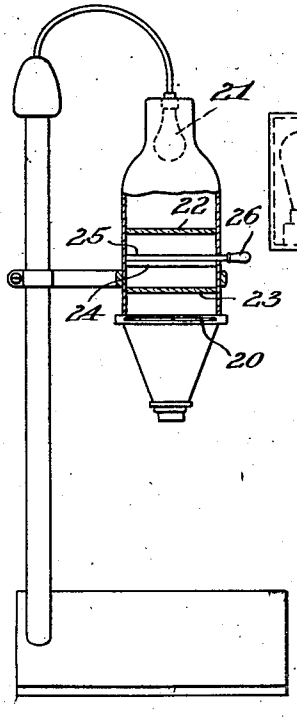


Fig. 3

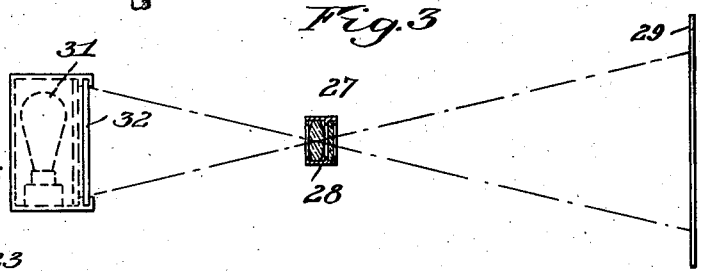


Fig. 4

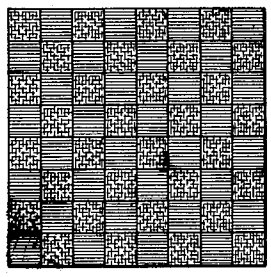
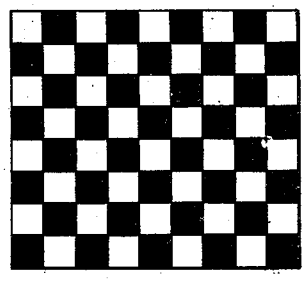


Fig. 5



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Fig. 6

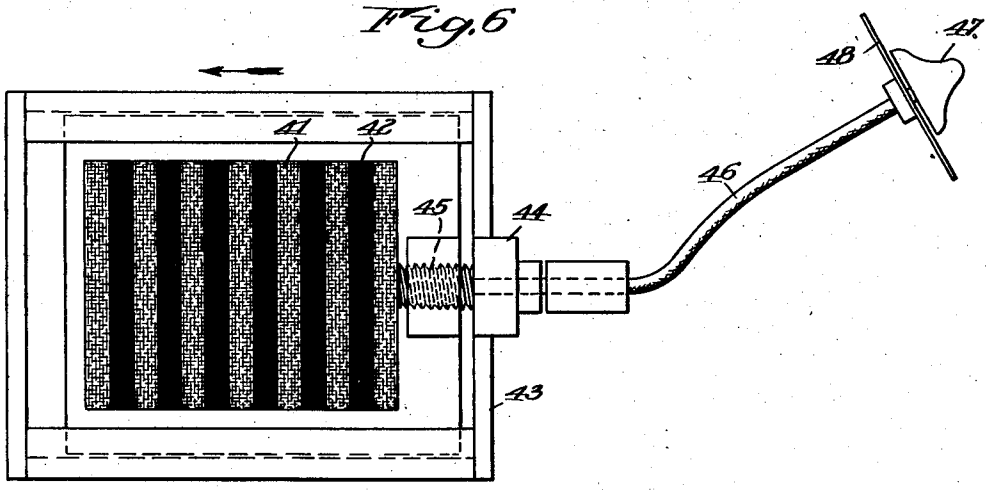


Fig. 7

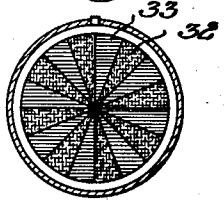


Fig. 8

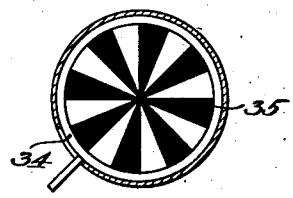


Fig. 9

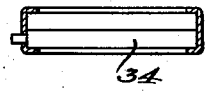


Fig. 10

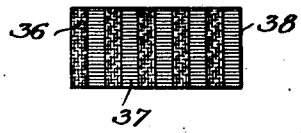
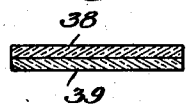


Fig. 11



Fig. 12



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UNITED STATES PATENT OFFICE

2,392,502

APPARATUS FOR MAKING PHOTOGRAPHIC PRINTS ON VARIABLE CONTRAST LIGHT-SENSITIVE MATERIAL

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Application June 8, 1944, Serial No. 539,232

1 Claim. (Cl. 95—73)

This invention relates to a method and apparatus for making photographic prints on variable contrast light-sensitive material, such for instance as disclosed in United States Patent No. 2,280,300.

The invention has to do with light-sensitive material coated with emulsion that is primarily sensitive to light characterized by wave-lengths within one spectral region and containing an element sensitive to light characterized by wave-lengths within a second spectral region, the emulsion being sensitive to light of two different colors, as for instance blue and yellow, and has for its object to afford a practical method and mechanism for accurately obtaining any desired proportion between two such colors and at the same time obtaining a thorough and intimate diffusion or mixing of the two colors, so that the desired proportionate color effect may be had over all portions of the variable contrast paper, and thus making it possible to obtain vastly superior results to what has heretofore been possible, by securing either a uniformly soft gradation, a uniformly high contrast, or any desired degree of contrast between the extreme limits uniformly at all points of the print.

A more particular purpose of the invention is to provide a structure including a filter that can be easily manipulated to obtain exactly the desired combination of two colors with uniform distribution and diffusion of the colors and without overlapping of differently colored areas of the filter or passing light composed of any color other than the two colors which go to make up the filter areas.

In printing on variable contrast material such as disclosed in Patent No. 2,280,300, the steepness of gradation depends upon the color of the printing light, as for instance, if paper is exposed through a conventional negative to blue light having a wave-length in the region of approximately 360 to 500 millimicrons, a high contrast image results, and if the material is exposed through the same negative to yellow light having a wave-length in the region beyond 500 millimicrons, a low contrast image is obtained, and it is a purpose of the invention to afford simple and efficient means for projecting and thoroughly diffusing light of two different colors in any desired proportion so as to maintain accurate control over the result.

It has been proposed to control such light by means of variously colored lamps through suitable rheostats, but such mechanism is objectionable since it is difficult to maintain correct color balance for each exposure because the length of time required for the light to reach peak intensity varies in accord with different settings of the rheostat, and consequently a short exposure might have a different color balance from a longer exposure.

It has also been proposed to vary the blue-yellow balance of the printing light by providing a number of different filters, one of which is selected and interposed for each exposure, in front of the light source, but this has serious objections because one of a set of filters has to be used and intermediate gradations between successive filters cannot be obtained in this manner.

It has also been proposed to vary the blue-yellow ratio by dividing the time of exposure between two filters interposed successively in front of the light source. This is disadvantageous in that it requires two separate filters and separate exposure calculations for each filter when it is desired to vary the exposure time, and further, an interrupted exposure is required in such a procedure which tends to induce inaccuracies in the overall exposure period.

Another plan has been to employ two juxtaposed filters of different colors and to control the blue-yellow ratio of the resulting light beam by changing the locus of the dividing line between the two colors, but this is open to the objection that there is insufficient diffusion of the light of the two different colors, one part of the light-sensitive material being subjected more to the light of one color whereas the remaining part of the light-sensitive material is subjected more to the light of the other color, and satisfactory results cannot be obtained due to insufficient distribution of the two colors over the entire area of the light-sensitive material.

A further purpose of the invention is to overcome the various objections stated above and provide a practical mechanism adapted for accurately controlling light composed of two colors in a photographic printer of either the contact or projection type, without the necessity of adjusting a lamp current, and in a way that insures proper combining of the colors in any required proportion by a simple operation that automatically varies one color inversely to the other, distributing and relating the areas of the different colors of the filter so as to insure adequate mixing of the two colors, and thereby obtaining a more accurate overall ratio of the two colors and a more uniform gradation over the entire image.

To these and other ends, the invention consists in the construction and arrangement of parts that will appear more clearly from the following description when read in conjunction with the accompanying drawings, the novel features being pointed out in the claims following the specification.

In the drawings:

Fig. 1 is a vertical sectional view of a contact printer showing the application thereto of a preferred embodiment of the invention;

Fig. 2 is a perspective view partially in section of a projection printer embodying the invention;

Fig. 3 is a diagrammatic view showing the application of the invention to an enlarging projection printer, where light is transmitted first through a negative and then through an enlarging lens and filter onto the light-sensitive material;

Fig. 4 is a view illustrating one form of filter with a multiplicity of series of alternate areas of different colors extending in two directions at right angles to each other;

Fig. 5 is a view showing the shutter employed with the filter of Fig. 4;

Fig. 6 is a view of an adjusting mechanism for the shutter;

Fig. 7 is a view showing a filter of a modified construction, in which there is rotative adjustment between the filter and a shutter;

Fig. 8 is a view of the shutter employed with the filter shown in Fig. 7;

Fig. 9 is a sectional view of the structure illustrated in Figs. 7 and 8 in which the color adjustment is determined by a relative rotative movement of the shutter and filter;

Fig. 10 is a plan view of a further modification of filter embodying the invention;

Fig. 11 is a similar view of the shutter employed with the filter of Fig. 10, and

Fig. 12 is a sectional view of the filter and shutter shown in Figs. 10 and 11.

The invention utilizes a single filter constructed to transmit light of two colors, for instance blue and yellow, although it is to be understood that the invention is intended to control any two colors, and the filter is divided into a series of relatively small areas which may be colored to transmit blue light and are separated by symmetrical alternate areas which may be colored to transmit yellow light, every portion of the filter being operative to transmit one or the other or any proportionate combination of the two colors, which are equally and uniformly distributed over all parts of the filter so as to bring about a thorough and intimate diffusion of the two colors to produce the desired effect on the variable contrast material at all points of the image.

This structure lends itself to an extremely simple control as it requires movement of only one element, either filter or shutter, to effect accurate and predetermined proportioning of two colors. Such a color controlling filter may be applied to a contact printer as illustrated in Fig. 1, in which 1 and 2 designate the sides and bottom respectively of a box or cabinet, while 3 and 4 designate the sides and bottom of a frame in which are supported the printing lights 5.

6 designates the top of the printing box provided with a transparent glass 7, while 8 and 9 designate respectively translucent light diffusion mediums of glass or other suitable material mounted above and below the filter, to be described presently. The diffusing members 8 and 9 may be used if desired, although they are not indispensable, as the light is thoroughly diffused by the series of spaced colored filter areas separated from each other by alternate intervening filter areas of a different color. Further, the filter elements may be made self-diffusing in a well known manner.

The filter is designated at 11 and is preferably supported stationarily in the frame immediately beneath the slidably adjustable shutter 12 which carries a handle 13, by which it may be adjusted over the filter to effect the desired proportioning of the two colors. When the shutter is adjusted to give the proper proportionate combination of blue and yellow, or other two colors, light is transmitted through the filter to the variable contrast light-sensitive material mounted upon the negative between the transparent layer 7 and the swinging platen comprising the heel board 14 hinged to the top of the cabinet at 15 by means of the hinge connection 16, and the toe board 17 hinged to the heel board 14 at 18, the platen being operated by a handle 19 as usual in contact printing mechanism. The light circuit may be controlled by a switch operated automatically when the platen is pressed down against the light-sensitive material, this mechanism and construction of the contact printer being well known and forming no part of the present invention, which relates only to the method and mechanism for controlling the proportioning and mixing of the two colors.

The filter is preferably in the form illustrated in Fig. 4, comprising a multiplicity of series of yellow areas for passing yellow light beyond the region beginning approximately at 500 millimicrons arranged in two directions at right angles to each other across the filter and spaced from each other by a multiplicity of series of symmetrical intervening alternate blue areas of the same size and shape as the yellow areas for passing blue light in the region of 360 to approximately 500 millimicrons, thus affording a checkerboard composed of multiple series of alternating yellow and blue areas extending in two directions across the filter at right angles to each other. Every portion of the filter is colored and forms a part of one or the other color areas, and to obtain any desired proportionate mixing of the two colors, there is preferably employed a shutter such as illustrated in Fig. 5 including a checkerboard arrangement of multiple series of opaque areas of the same size and shape as the areas of one or the other colors of the filter and extending in both directions across the shutter, the intervening spaces between the opaque areas of the shutter being transparent.

The shutter is provided with one additional series of open and opaque areas in the direction of its adjusting movement over the filter so as to permit movement of the shutter to the extent of the width of one colored area while covering every portion of the filter. This construction of shutter makes it possible to expose all the areas of one color, blue for instance, while shutting off all areas of the other color, or vice versa, or to obtain any proportionate combining of the two colors, as for instance, half of blue and half of yellow, or one-quarter of blue and three-quarters of yellow, or any other required proportionate relationship.

In every instance, the two colors can be accurately proportioned to give an overall proper color balance and are uniformly dispersed and distributed so that the exact proportionate color

combination is effective at every portion of the light-sensitive material to give a uniform gradation or contrast, which cannot be had with a filter in which there are only two color areas, each extending over a given part of the filter and not interrupted by the second color, because with such an arrangement, the blue color at one side of the filter is more effective upon the corresponding side of the light-sensitive material, and the yellow color at the other side of the filter is more effective upon the other side of the light-sensitive material, and it is impossible with such a filter to obtain sufficient dispersion of two colors to secure satisfactory gradation on variable contrast paper.

Fig. 2 illustrates the adaptation of the invention to a projection printer, in which 20 designates the negative and 21 is a lamp. The diffusion elements are shown at 22 and 23 respectively, 24 is the filter and 25 is an adjustable shutter with a handle 26 for controlling the same. Fig. 3 illustrates an application of the invention to an enlarging projection printer in which 27 designates the filter controlling instrumentalities located in the path of the light, between the enlarging lens 28 and the light-sensitive material 29, as shown, or between the lens and the negative, preferably in juxtarelation to the lens, or to the opening in the lens housing, for subjecting the light to the effect of the two proportionately combined colors, while 31 designates the lamp and 32 is the transparent negative, from which the image is projected through the lens on to the variable contrast light-sensitive material 29. In this case, it is necessary that the colored filter shall not be self-diffusing in order not to affect the resolution.

Figs. 7 and 8 illustrate a modification of the construction where it may be preferred to employ a rotative adjustment, the structure consisting of a circular filter element composed of a series of spaced segmental yellow areas 32, separated by alternate symmetrical intervening blue areas 33, and the desired proportioning of the two colors is obtained by a rotatable shutter indicated at 34 and including a series of segmental opaque areas 35 separated by alternate intervening symmetrical open areas and corresponding to the segmental colored areas 32 and 33 of the filter. By rotating the shutter 34, the opaque areas 35 are positionable to cover any desired portions of the blue or yellow filter segments, the remaining areas being uncovered, and any proportion between the yellow and blue areas can be had by rotatively adjusting the shutter.

Another modification of the invention is illustrated in Figs. 10 to 12, which disclose a filter including alternate parallel areas in the form of bands of yellow and blue extending across the filter and of uniform width, 36 designating the yellow areas or bands extending across the filter from one edge to the other and separated by symmetrical blue areas or bands 37, all forming part of the filter designated at 38 in Fig. 12. Proportioning and combining of the two colors is controlled by a slidable shutter 39 which includes alternately arranged opaque and transparent areas in the form of bands corresponding to the color areas of the filter, and by adjusting the shutter through a sliding movement to the extent of the width of one color band, either of the two colors may be uncovered and the other color blocked out, or any proportioning of the two colors can be had. When the colors are combined, they are so uniformly distributed over the entire filter as to give a thorough and complete diffusion or mixing of the two colors and thus create an image of uniform gradation at all parts of the light-sensitive material.

In Fig. 6 is illustrated a possible mechanism that lends itself readily to fine adjustment of a slidable shutter for obtaining different combinations of two colors. In this arrangement, the yellow areas of the filter, indicated at 41, are shown exposed through the transparent areas of the shutter while the blue areas of the filter are covered by the opaque areas or bands 42 of the shutter. The shutter is slidable in relation to the filter and is designated at 43, being slidably mounted in a suitable frame and provided with a nut 44 which is engaged by a screw 45 suitably mounted in the frame for rotative movement and fixedly connected to a flexible shaft 46 which may be turned by a button or dial 47, while 48 is a stationary scale to show the extent of movement of the adjusting dial 47 and thus enable the operator to turn screw 45 so as to effect exactly the required sliding movement of nut 44 and the shutter connected thereto to give the required proportioning of the two colors.

While the invention has been described with reference to the structural details disclosed, it is not confined to the exact mechanisms or structures herein shown, and this application is intended to cover any modifications or adaptations of the invention coming within the purposes of the invention and the scope of the following claim.

I claim:

Mechanism for obtaining variable effects when projecting through a negative onto variable contrast light-sensitive photographic material sensitive to light of two different colors comprising a two-color filter having a series of areas in the form of parallel bands of one color distributed uniformly over the filter and spaced from one another by a series of intervening alternate areas in the form of parallel bands of a second color having the same size and shape as the first mentioned areas and distributed uniformly over the filter, said two series of color bands occupying the entire area of the filter, and a shutter having two series of alternate transparent and opaque areas in the form of parallel bands corresponding respectively in size to the two series of colored areas of the filter, the filter and shutter being relatively adjustable to prevent passage of light except through said colored areas and to pass light composed of varying proportions of the two colors, the two colors being distributed over all portions of the filter and automatically variable inversely.

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