Sept. 3, 1940. F. BUSSE 2,213,382

APPARATUS FOR COMPENSATING FOR INCORRECT REPRODUCTION OF COLOR IN COLOR PHOTOGRAPHS

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Fig. 1

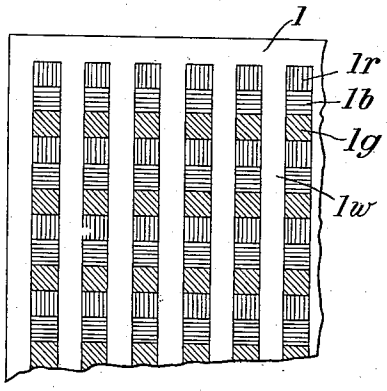


Fig. 2

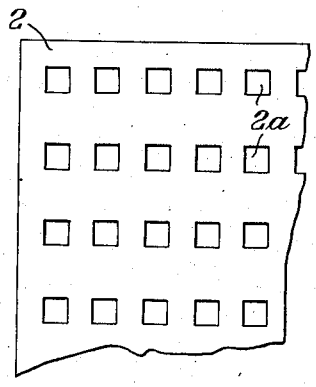


Fig. 4

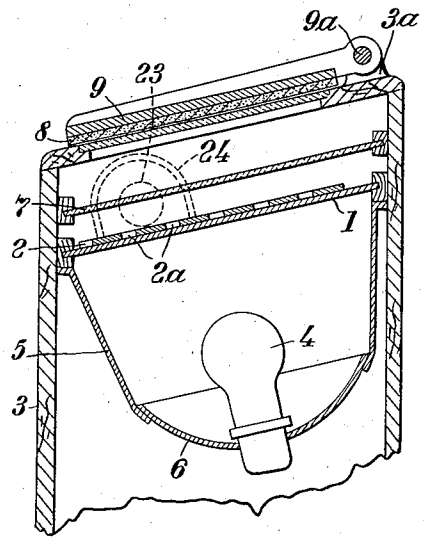
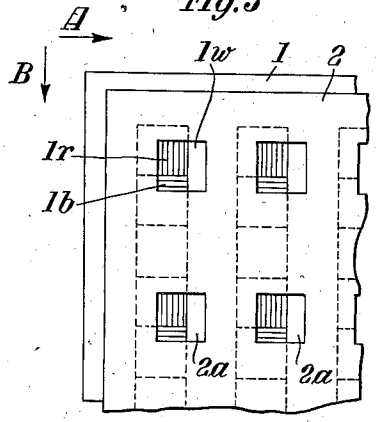


Fig. 3



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Fig. 5

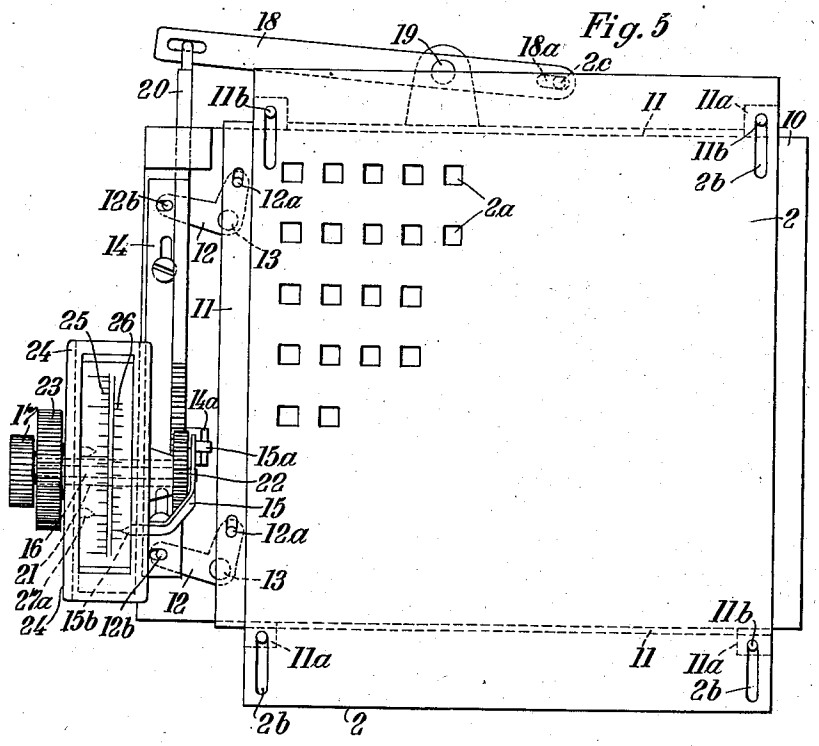
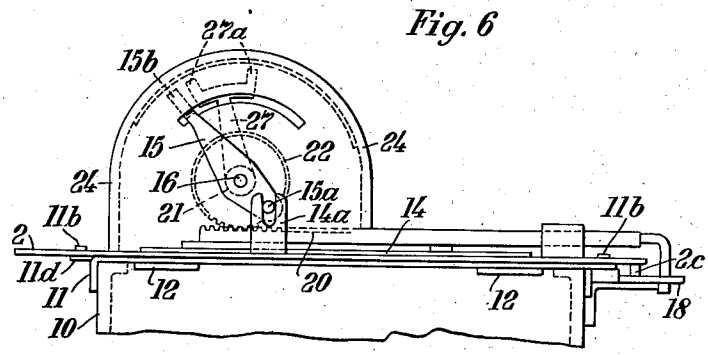


Fig. 6



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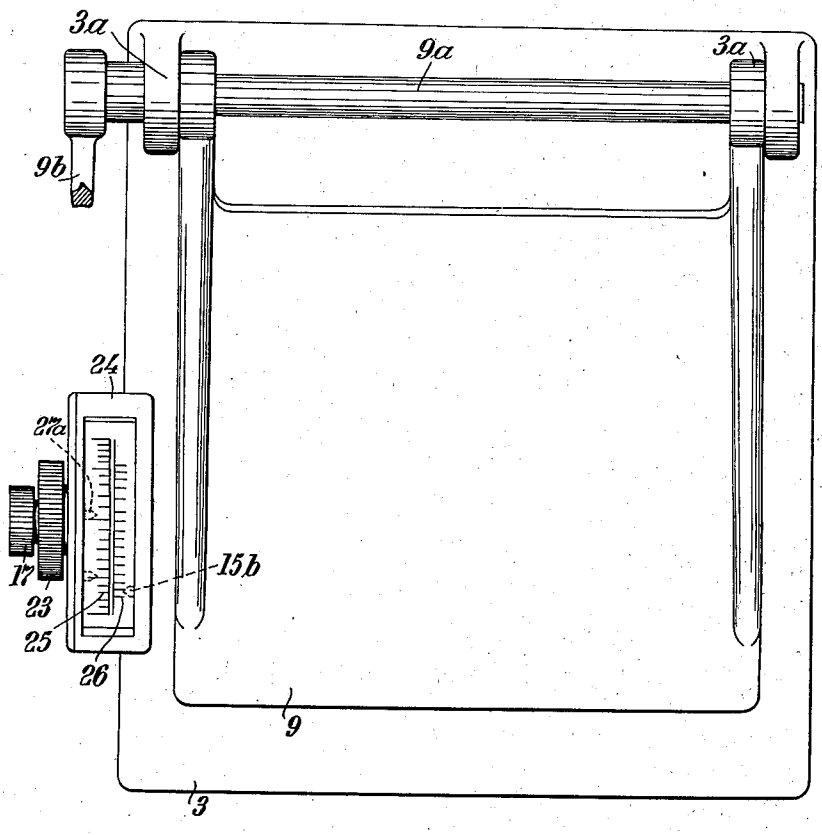
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Fig. 7



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UNITED STATES PATENT OFFICE

2,213,382

APPARATUS FOR COMPENSATING FOR INCORRECT REPRODUCTION OF COLOR IN COLOR PHOTOGRAPHS

Ferdinand Busse, Munich, Germany, assignor, by mesne assignments, to General Aniline & Film Corporation, New York, N. Y., a corporation of Delaware

Application August 17, 1939, Serial No. 290,590
In Germany August 22, 1938

11 Claims. (Cl. 95—73)

My present invention relates to improvements in compensating for incorrect reproduction of color.

It is often experienced in color photography that the color tones of the finished picture are not a correct reproduction of those of the object photographed. Such incorrect rendering of color may be due for instance to the conditions of illumination or to an incorrectly chosen time of exposure. In this case the photographs show an excess of one or another color.

In order to remove the errors in the reproduction it has already been proposed to rectify the color value during copying. It is, for example, known in copying from lenticular films to remove during reproduction the errors in the colors by controlling diaphragms in front of the several color filters with the aid of a color triangle. Such control is effected by a device displaceable in two dimensions and necessitates a complex electric circuit with the use of electric relays.

It is an object of my invention to provide a simple apparatus for compensating for reproductions of color during copying or enlarging color photographs.

Another object of the invention is to provide in the path of the copying light a filter which has uncolored fields and fields colored in the primary colors, the area of each of the colored fields being equal to one another and in their sum equal to the total uncolored area.

Further objects of my invention will appear from the detailed description following hereinafter.

The filter is combined with means which enable the copying light to pass through selected fields or combinations of fields. The fields colored in the primary colors may be arranged in vertical strips which alternate with parallel uncolored strips of equal width. The uncolored fields may be transparent or they may consist of a grey filter or a grating screen, the blackening of the grey filters or the density of the grating screens preferably being such that the absorption of light thereby is equal to the absorption of light by the colored fields.

In order to enable the copying light to pass through selected fields or combinations of fields, that is in order to cover the unwanted fields of the filter, there may be arranged over the latter an apertured screen which can be displaced parallel to the filter in a system of coordinates corresponding with the arrangement of the colored and uncolored fields. This screen has apertures which correspond exactly with the number, size, shape and position of the fields of a given color of the filter. The screen is moved by two adjacent coaxial rotatable knobs, the rotation being transmitted to the screen by suitable gear, for example toothed wheels, racks and crooked levers, in such a manner that one knob serves to select the percentage of the uncolored fields to be combined and the other to select the colored fields to be combined. For quantitative adjustment of the light passing through the colored and uncolored fields two scales concentric with the knobs are provided of which one shows the colored component selected and the other serves for the adjustment of the uncolored light which is to be combined with the colored light. The scale for selecting the combination of colors has subdivided adjacent fields of equal size colored in the primary colors, the percentage of which can be read off by means of a double pointer connected with the knob. The uncolored transmitted light is adjusted by a pointer connected with the other knob.

The invention is illustrated by way of example in the accompanying drawings, in which

Fig. 1 is a view of the filter,

Fig. 2 is a view of perforated screen for partly covering the filter.

Fig. 3 is a view of the filter with the screen superimposed.

Fig. 4 is a section through copying apparatus in which the filter and screen have been inserted.

Fig. 5 is a view of apparatus for controlling the screen.

Fig. 6 is a side view of the control apparatus shown in Fig. 5, and.

Fig. 7 is a view of the copying apparatus shown in Fig. 4.

The screen 1 shown in Fig. 1 has vertical strips of equal breadth, the strips being alternately colorless and composed of colored fields. The colored fields which are arranged one below the other and are of equal size are colored in regularly recurring order in the primary colors red ($1r$), blue ($1b$) and green ($1g$). The uncolored strips $1w$ are white, they may, however, be transparent of may consist of grey filters or grating screens, the blackening of the grey filters or the density of the grating screens preferably being such that the absorption of light thereby is equal to the absorption of light by the colored fields. By such an arrangement of colored and uncolored fields it is possible with the aid of a mask, for example apertured screen 2 (see Fig. 2), to alter the light falling on the negative, for the

purpose of color correction in a copying or enlarging apparatus, a selection being made from white light and a combination of white light and filtered light one or more of the primary colors red, green or blue. The apertured screen 2 for covering the unwanted combinations of colors has apertures 2a which in respect of their number, shape and size correspond with the colored fields and are so arranged that they are separated horizontally by the length of one colored field and vertically by the height of two colored fields.

If such a screen 2 is superimposed on the color filter 1 any desired part of a colored or uncolored field can be freed for the passage of the copying light by displacing the screen 2 parallel to the filter 1 in the directions of a pair of rectangular coordinates.

Such a displacement of the screen 2 in relation to the filter 1 is illustrated in Fig. 3. By the displacement of the screen 2 in the directions of the arrows A and B only the parts of the fields 1r, 1b and 1w shown behind the apertures remain open for the passage of the copying light. From Fig. 3 it can be seen that the proportion of white light and light of the primary colors can be varied in any desired manner by further displacement of the screen 2.

The arrangement of the filter 1 and screen 2 in a copying apparatus can be seen from Fig. 4 in which 3 denotes the housing of the apparatus, 4 the source of light, 5 and 6 a reflector for the source 4, 7 a diffusing screen, 8 the copying material and 9 the pressure plate. The pressure plate is mounted on a shaft 9a which turns in bearings 3a and is actuated by a lever 9b (see Fig. 7). Between the diffusing screen 7 and the source of light 4 is situated the filter 1 and superimposed screen 2.

The apparatus shown in Figs. 5 and 6 enables the color necessary for the compensation of a given incorrectness of reproduction to be obtained by controlling the movements of the screen 2 in front of the filter 1. The apparatus comprises a base plate on which the screen 2 is arranged so as to be movable in the directions of a pair of rectangular coordinates, the screen being carried in a movable frame 11. The frame 11 has at its upper and lower ends lugs 11a which engage by means of pins 11b in slot guides 2b in the screen 2. The frame 11 is moved to and fro by two crooked levers 12 which pivot on fulcra 13 on the base plate 10 and are connected with the frame 11 by pins and slots 12a. The crooked levers 12 are driven by a rod 14 which has a fork-shaped lug 14a (see Fig. 6) in which a pin 15a of the pointer arm 15 engages. The pointer arm 15 is mounted on an axle 16 which is connected with the small knob 17. By turning the knob 17 the rod 14 is displaced and the displacement is transmitted to the levers 12 by pin and slot connections 12b.

For the movement of the screen 2 on the frame 11 in the direction of the ordinates, the screen is provided with a pin 2c which is engaged by a slot 18a in a lever 18. The fulcrum 19 of the lever 18 is fixed to the base plate 10 and the lever is moved by a rack 20 which is driven by a toothed wheel 22 mounted on a hollow shaft 21. On the other end of the shaft 21 is mounted the large knob 23.

Round the shafts 16 and 21 is a housing 24 on which two neighbouring translucent scales 25 and 26 are marked. The scale 25 consists of colored fields of equal size which are arranged from above to below in the order red, blue, green, red, that is in the same order as the colored fields of the filter. On the shaft 21 is fixed a double pointer 27 of which the ends 27a traverse the scale 25 at a distance apart of one colored field of the scale. The scale 26 indicates the displacement of the screen 2 over the uncolored fields 1w. It is advantageous to express the extent to which the uncolored fields are free as a percentage of uncolored light. For this purpose the percentage of uncolored light is read off the scale 26 by means of the end 15b of the pointer 15 which is fixed on the shaft 16.

The apparatus works in the following manner. If, for example, a test has shown that to compensate for an incorrect rendering of color it is necessary to use a copying light containing 40 per cent of red, 20 per cent of blue and 40 per cent of white, it is only necessary to turn the large knob 23 for adjusting the colored light so far that the end 27a of the double pointer points to 40 per cent on the red field and 20 per cent on the blue field of the scale 25, and to turn the finger 15b for adjusting the white light to the appropriate percentage number on the scale 26. The screen 2 then occupies approximately the position shown in Fig. 3. In exactly the same manner the screen 2 can be adjusted to free the fields of a single color or the uncolored fields. If the absorptivity of the uncolored fields (grey filter) is made equal to that of the individual colored fields, the absorption of light by the filter remains the same independently of which field or combination of fields is freed by the screen. This has the advantage that the quantity of light falling on the copying material is always the same, so that alteration of the exposure time when compensation for incorrect color is not necessary.

I claim:

1. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with uncolored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, and means for enabling the copying light to pass through selected fields of said filter.

2. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with uncolored fields and fields colored in the primary colors, said uncolored and colored field being so arranged that rows of said uncolored fields alternate with rows of said colored fields, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, and means for enabling the copying light to pass through selected fields of said filter.

3. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with transparent uncolored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, and means for enabling the copying light to pass through selected fields of said filter.

4. In an apparatus for compensating, during the copying or enlarging of color photographs,

for incorrect reproduction of color in said photographs, in combination, a filter provided with grey-colored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said grey-colored fields, and means for enabling the copying light to pass through selected fields of said filter.

5. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with uncolored fields consisting of grating screens and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, and means for enabling the copying light to pass through selected fields of said filter.

6. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with grey-colored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said grey-colored fields, the blackening of said grey-colored fields being such that the absorption of light thereby is equal to the absorption of light by said colored fields, and means for enabling the copying light to pass through selected fields of said filter.

7. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with uncolored fields consisting of grating screens and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, the density of said grating screens being such that the absorption of light thereby is equal to the absorption of light by said colored fields, and means for enabling the copying light to pass through selected fields of said filter.

8. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with uncolored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, and an apertured screen arranged over said filter and adapted to be displaced parallel to said filter in the directions of a pair of coordinates corresponding with the arrangement of the fields.

9. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with uncolored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, an apertured screen arranged over said filter, two adjacent coaxial rotatable knobs adapted to displace said screen parallel to said filter in the directions of a pair of coordinates corresponding with the arrangement of the fields, and a combination of toothed wheel, rack and crooked lever for transmitting the rotation of said knobs to said screen.

10. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination, a filter provided with uncolored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, an apertured screen arranged over said filter, two adjacent coaxial rotatable knobs adapted to displace said screen parallel to said filter in the directions of a pair of coordinates corresponding with the arrangement of the fields, two adjacent scales arranged concentric with said knobs, one of said scales serving for the quantitative selection of uncolored fields and the other scale for the quantative selection of colored fields, and a combination of toothed wheel, rack and crooked lever for transmitting the rotation of said knobs to said screen.

11. In an apparatus for compensating, during the copying or enlarging of color photographs, for incorrect reproduction of color in said photographs, in combination a filter provided with uncolored fields and fields colored in the primary colors, the area of each of said colored fields being equal to one another and in their sum equal to the total area of said uncolored fields, an apertured screen arranged over said filter, two adjacent coaxial rotatable knobs adapted to displace said screen parallel to said filter in the directions of a pair of coordinates corresponding with the arrangement of the fields, two adjacent scales arranged concentric with said knobs, one of said scales serving for the quantitative selection of uncolored fields and the other scale for the quantitative selection of colored fields, said scale for the selection of colored fields having subdivided adjacent fields of equal size colored in the primary colors, a double pointer connected with one of said knobs and serving for reading off the percentage of the primary colors, and a combination of toothed wheel, rack and crooked lever for transmitting the rotation of said knobs to said screen.

FERDINAND BUSSE.