

P. D. BREWSTER.
 DIFFERENTIAL DEVELOPMENT OF COLOR CINEMATOGRAPHIC FILMS.
 APPLICATION FILED JAN. 27, 1917. RENEWED JULY 30, 1921.

1,410,884.

Patented Mar. 28, 1922.

3 SHEETS—SHEET 1.

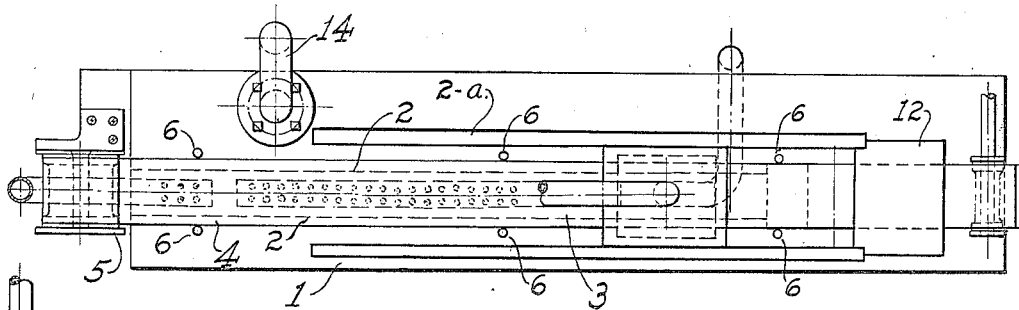


Fig. 2

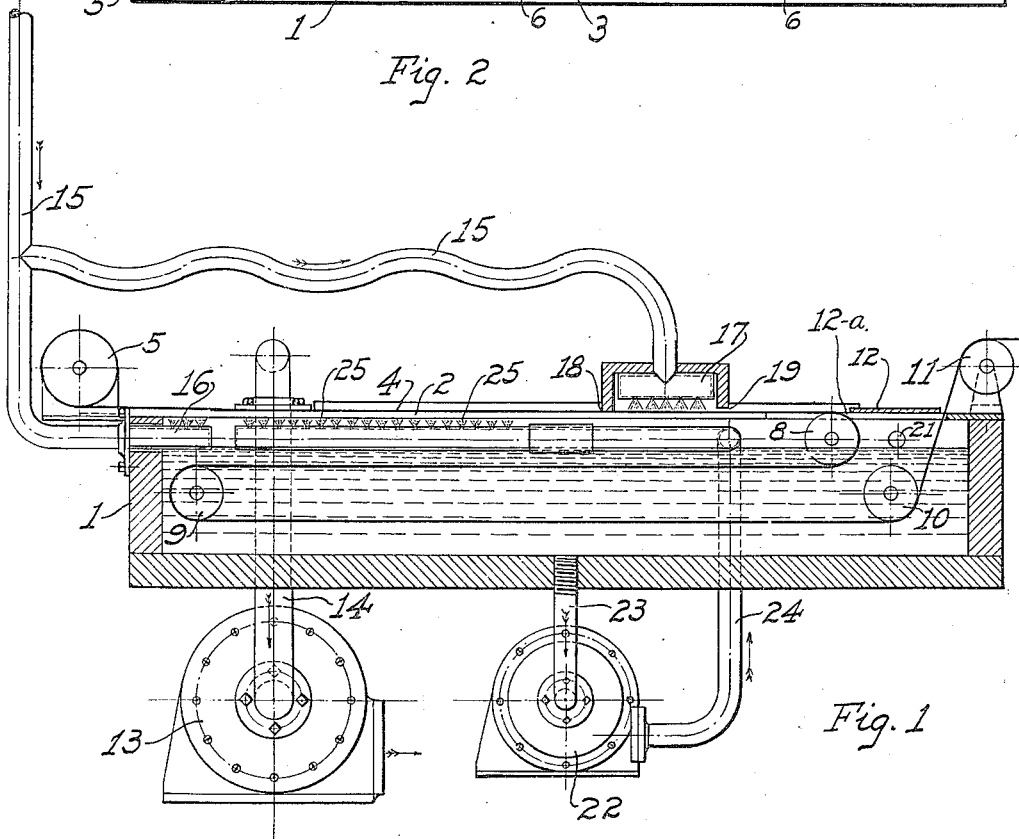


Fig. 1

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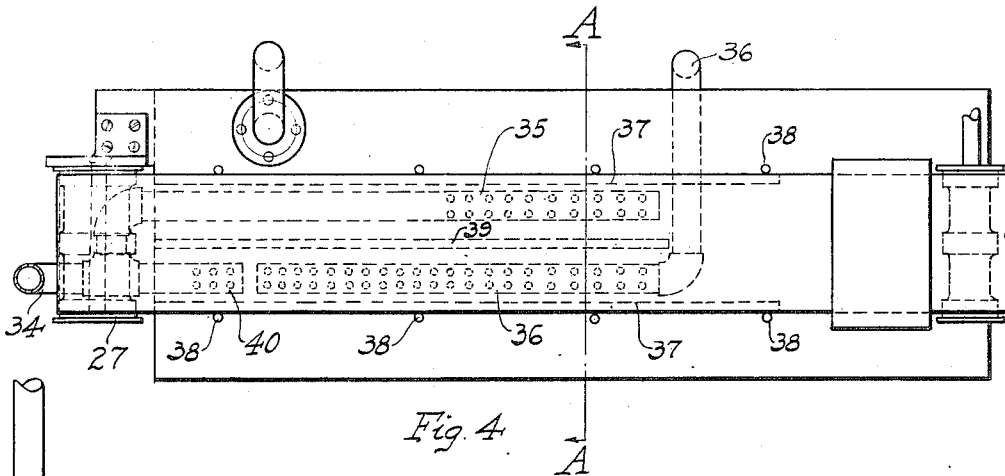


Fig. 4.

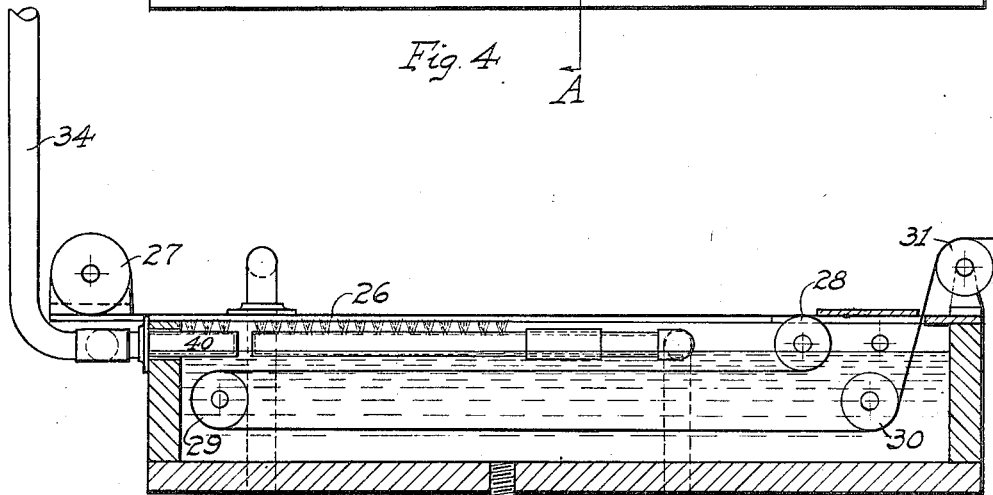


Fig. 3.

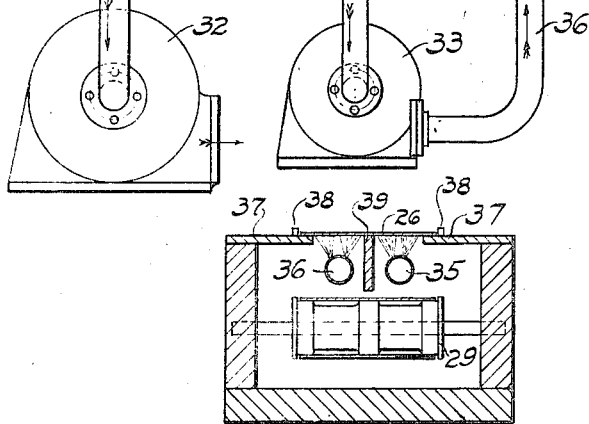


Fig. 5.

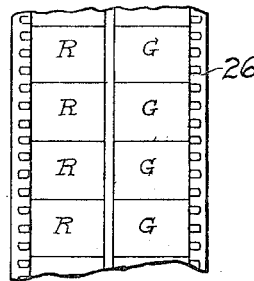


Fig. 6.

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3 SHEETS—SHEET 3.

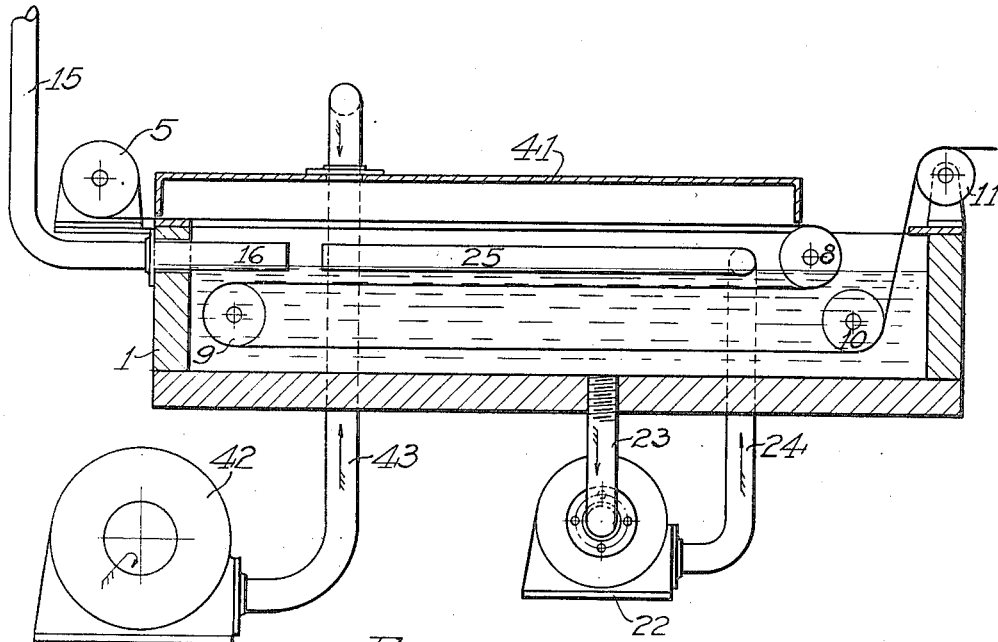


Fig. 7.

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UNITED STATES PATENT OFFICE.

PERCY D. BREWSTER, OF EAST ORANGE, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO BREWSTER PATENTS CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

DIFFERENTIAL DEVELOPMENT OF COLOR CINEMATOGRAPHIC FILMS.

1,410,884.

Specification of Letters Patent. Patented Mar. 28, 1922.

Application filed January 27, 1917, Serial No. 144,841. Renewed July 30, 1921. Serial No. 488,680.

To all whom it may concern:

Be it known that I, PERCY D. BREWSTER, a citizen of the United States, residing at East Orange, Essex County, New Jersey, have invented new and useful Improvements in Differential Development of Color Cinematographic Films, of which the following is a specification.

My present invention relates to the development of color cinematographic films, in methods of color cinematography in which two series of negative images taken through separate color filters are printed on the same positive film and the resulting positive images colored in monochrome so that the blending of the monochrome images in projection will reproduce the colors of the scene photographed.

My invention provides means for controlling the relative amount of development of the series of color value images taken through one filter, say orange-red, in relation to the development of the other color value image series, taken through the other filter, say blue-green.

It is a well established fact that if a scene be photographed by red light and by green light and developed the same length of time in the same developer, the "red" negative taken through the red filter, will be far more contrasty or have a higher gamma than the "green" negative. In other words the silver deposit representing the deep shadows in the object photographed, if the relative exposure was correct, would be about equal in the "red" and "green" negatives while the high lights would be far denser on the "red" negative. When printed on a positive these conditions would naturally be reversed, the positive, printed from the "red" negative to be stained green, would have very thin high lights and relatively dense shadows, while the print from the "green" negative to be stained red would be just the opposite, having thin shadows and heavy high lights so that when the picture was projected the general tendency would be toward greenish shadows and reddish high lights. For example, the tendency is to make a person's complexion (a high light) red, and the dark clothes or hair (relatively a shadow) green, a tendency which is always characteristic of two color work.

If the development of the "red" negative

be materially reduced in relation to the "green", the scale of contrasts of gammas will be more nearly correct and the resulting prints will reproduce the scene photographed with materially lessened color distortion due to varying contrasts.

At present the usual practice is to rather underexpose the "red" negative and to overdevelop it while the "green" negative is given practically correct exposure and development, thereby rendering correctly the middle tones in the finished picture and having a moderate excess of red in the high lights and green on the shadows, the relative exposure of the "red" and "green" negatives being judged from the most pleasing final color blend rather than the actually correct exposure.

According to my invention I prefer to give the "red" a longer exposure and shorter development than ordinarily used in the prevailing practice.

I prefer to determine the speed of the film through the orange-red and blue-green filters to be used in the camera by the well known Hurter and Driffield system (photo-miniature #56, Nov. 1903) in which the speed of the sensitized emulsion on the film to the different color lights is indicated by a numerical scale and the relative exposures made in accordance with the scale.

The development of the two negatives is so proportioned that the whites or greys of the object photographed are rendered in similar densities in the two negatives or, in other words, the two gamma or contrast lines are parallel. The determination of these relative times is readily effected by developing a series of "red" images for different lengths of time, for instance the first for a time definitely known but somewhat less than what is judged (from experience) to be the proper, the second for a known longer time, etc. A series of "green" images is developed in like manner, and the two series are then compared (by the Hurter and Driffield method referred to above) and the images having equal gammas are found. The development times for these images are then noted. For example, it may be found that the third "red" development time, which was, say, two minutes, and the fifth "green" development time, which was, say, three and a half minutes, have equal gammas. Ac-

cordingly the red images will be developed two minutes and the green images three and a half minutes.

To accomplish this result it is necessary to treat one series of images longer with the same developer or to use developer of different strengths on the two image series. The method of operating the first of these systems is illustrated in the accompanying drawings, in which—

Fig. 1 is a diagrammatical section and Fig. 2 is a plan of a developing machine adapted to treat film with one image series on one side and the other image series on the other side. Figs. 3 and 4, respectively, are similar views of a developing machine adapted to treat film with the images series side by side. Fig. 5 is a section through the machine, about on line *a—*a** of Fig. 4. Fig. 6 is a plan view of the type of film used in the machine illustrated in Figs. 3 and 4. Fig. 7 is a diagram of a machine where pressure is used in place of vacuum to hold film in place.

The tank 1 is constructed with a slot 3, preferably along its top formed by the rails 2, 2 and having a width about equal to the distance between the perforations in the film to be used. The film 4 is mounted on spool 5 and passed over the slot 3 preferably guided by pins 6, 6 over rollers 8, 9, 10 and 11. The film is drawn constantly and continually through the machine by any desired means.

Negative film is preferably run across the slot 3 with the "red" images on top while if positive film (with the images on its opposite sides) is being developed the image series which is to be stained "green" is on top so that it will receive the shorter development.

The edges of the film are held in close contact with the rails by the slight vacuum maintained in the tank by the exhaustor 13, through pipe 14 which also prevents the escape of any developer by maintaining a current of air into the tank through any crevice between the film and the rails. It is frequently desirable to first treat the film with absolutely fresh developer and then continue the development with partly used developer. Fresh developer is led into the machine through pipes 15, 15 and sprayed on the two sides of the film through sprays 16, 17 respectively so that both sides of the film are acted upon first by the fresh developer. The connection to the spray 17 is preferably through the flexible pipe 15 so that the relative duration of the development of the two sides of the film can be controlled by shifting the spray back and forth along the rails. The front lip 18 and sides of the spray 17 are arranged to make a close contact with the film rails while the end 19 toward roller 8 is left open so that the excess of developer, aided preferably by a slight incline, will

flow into opening 12^a where it is drawn by inrushing air into the tank. The longer expanse of film exposed in the slot requires a greater amount of developer which may be provided by the use of the pump 22, adapted to draw developer in from the tank through pipe 23, and to discharge it through pipe 24 and the series of sprays against the underside of the film 4. Outlet 21 provides an overflow for any excess developer.

Figures 3, 4 and 5 illustrate the machine adapted to treat film of the general type shown in Fig. 6 in which the red and green images extend side by side down the film on the same side. The film 26 is wound on spool 27 and led across the treating slots with the margin containing the perforations in contact with rails 37, 37' guided by the pins 38, 38, 38. If the film has a space between the red and green images, preferably the partition 39 is arranged to maintain contact with the film. The film then passes over rollers 28, 29, 30, 31 successively being drawn by any suitable means.

Fresh developer under pressure is led into the machine through pipe 34 and into spray pipes 35 and 40 so arranged that both of the image series are first acted upon by fresh developer. The relative positions of the sprays 35 and 40 determining the amount of differential developing by the time one image is acted upon until the corresponding image in the other series is acted upon. To continue the action of the developer on the side having the longer development the machine is preferably equipped with an auxiliary spray through pipe 36 fed from pump 33 which withdraws the developer in the tank and discharges it through the sprays. The exhaustor 32 is adapted to maintain a slight vacuum under the film to hold it in contact with the slot.

Fig. 7 illustrates a machine of similar structure except that instead of maintaining a slight vacuum in the tank to hold the film in place, a cap 41 is constructed over the slot and a slight pressure is maintained on the film by means of the fan 42, the outlet pipe 43 of which is connected to the cap 41.

In three color cinematography with three images side by side, or two images side by side and the third image on the other side it is apparent it would be possible to give all three films different developing times.

Differential development could also be secured by treating the different image series with developer of different strengths.

I claim:—

1. In the art of color cinematography in which a plurality of series of images of different color values, including red and green are produced, the improvement comprising developing the green series of images to a

greater degree than the red whereby substantially equal density is obtained in selected portions of the images of the series.

2. In the art of color cinematography in which a plurality of series of images of different color values, including red and green are produced, the improvement comprising developing the green series of images for a longer time than the red whereby substantially equal densities are produced in the high-lights of the images of the red and green series.

3. In the art of color cinematography in which a series of color value images recording the action of light transmitted through a red filter and a series of color value images recording the action of light transmitted through a green filter are produced, the improvement comprising developing to substantially the normal degree the series of images which are to be colored red, and developing the other series to less than the normal degree, whereby substantially equal

densities are produced in the high-lights of the two series.

4. In the art of color cinematography in which a series of color value negative images recording the action of light transmitted through an orange-red filter and a series of color value negative images recording the action of light transmitted through a blue-green filter are produced, the improvement comprising developing the blue-green series to produce a desired degree of contrast, and developing the orange-red series to produce in the high-lights thereof substantially the same density as in the high-lights of the blue-green series.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this fifth day of January, 1917.

PERCY D. BREWSTER.

Witnesses:

THOMAS D. BERAU,
E. M. THEISE.