Oct. 4, 1932. F. TUTTLE 1,880,596

PHOTOGRAPHIC PRINTING APPARATUS

Filed Sept. 10, 1931 2 Sheets-Sheet 1

Fig. 1.

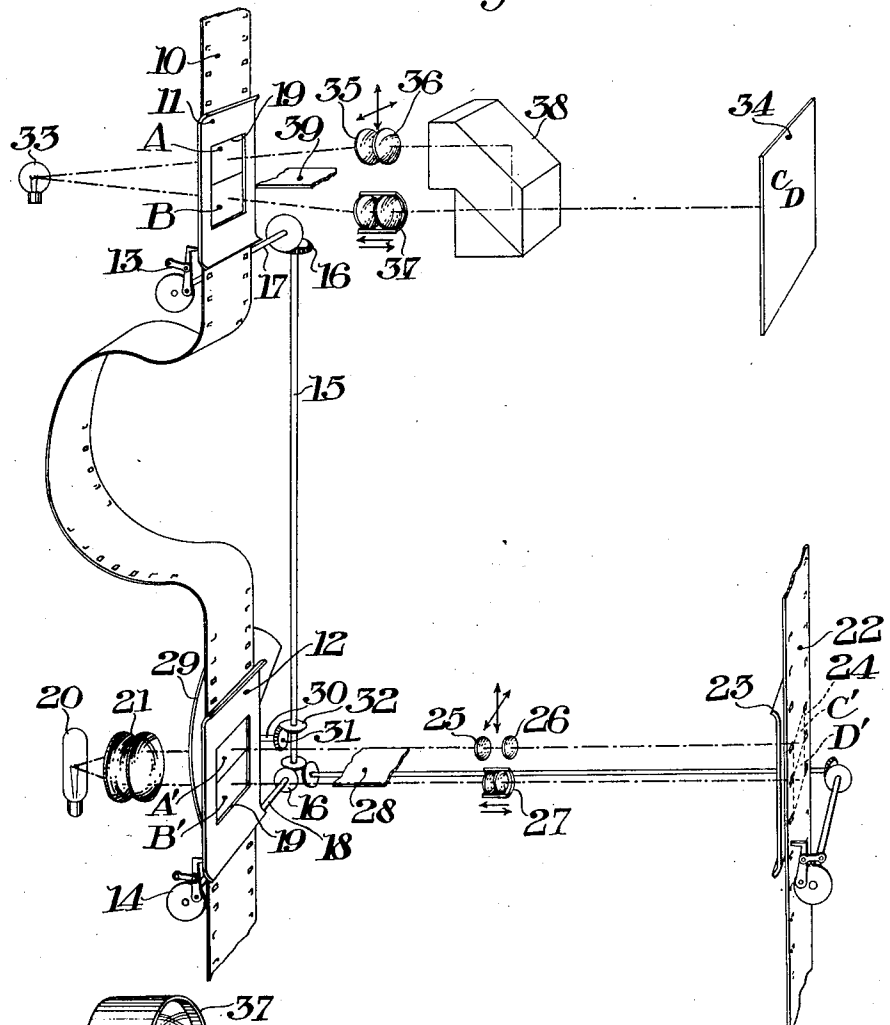
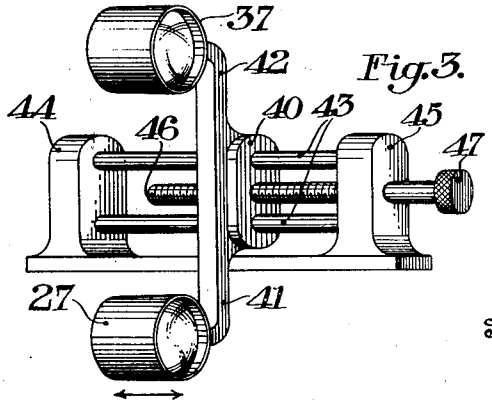


Fig. 3.



Inventor:
Fordyce Tuttle,
By Newton M. Perrin
Rolla N. Carter
Attorneys.

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Fig. 2.

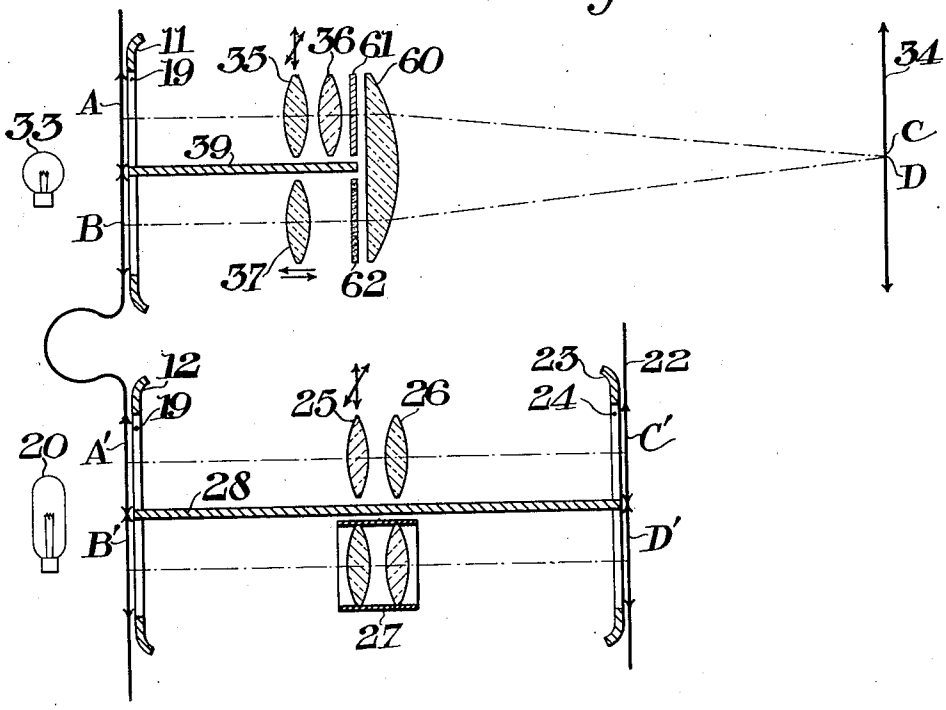
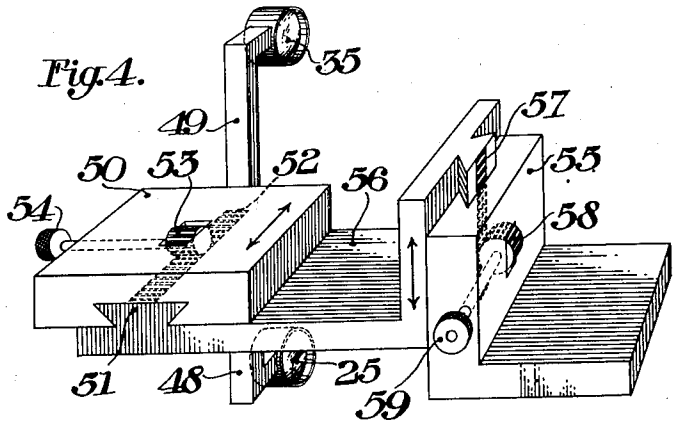


Fig. 4.



Inventor:
Fordyce Tuttle,

By Weston M. Perrins
Rolla N. Carter
Attorneys.

Patented Oct. 4, 1932 1,880,596

UNITED STATES PATENT OFFICE

FORDYCE TUTTLE, OF ROCHESTER, NEW YORK, ASSIGNOR TO EASTMAN KODAK COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK

PHOTOGRAPHIC PRINTING APPARATUS

Application filed September 10, 1931. Serial No. 562,084.

My invention relates to the art of photographic printing by projection, and more particularly to a method and apparatus for accurately registering two complemental images in spaced relation upon a sensitized element.

In the production of motion picture film by the color separation process it is customary to make two series of color records on different films or on the same film. From these color records is made a master positive which is usually a series of records on a continuous strip, the records of the two color series alternating. From this master positive, images are printed in registry upon opposite sides of double coated stock, or in series on ordinary film and afterwards projected in any well known manner.

It is well known that photographic film shrinks in the course of its treatment and that a master positive printed by contact from a developed negative will contain many errors. This is particularly true if on a single long strip of master positive are printed a number of different scenes taken from different negatives exposed and developed at different times and under different circumstances. It is customary to join a series of such scenes and print them together. A master positive printed in this way would lack uniformity and in printing from it, it would be necessary to adjust the printer between each scene so as to insure proper registry and focus of the images.

In accordance with my invention I have overcome these difficulties in the master positive due to such differences in the negative so that when the positive has been made it will be uniform throughout and when the printer has once been set it may be used continuously for repeated printing from the same positive without further resetting. I have accomplished this by providing means for projecting two spaced images in superposition upon a screen for visual inspection and means for projecting two spaced images upon the sensitive film being printed, the two means being interconnected so that registration of the superposed images assures the proper magnification and positioning of the printing images.

I do not limit myself to any particular color process nor to a color process, but propose to utilize my invention wherever it may be necessary or desirable to print, two at a time, projected images of the same size or in which the corresponding points should be accurately registered or located.

My invention will be readily understood from the following description when read in connection with the accompanying drawings in which Fig. 1 is a diagrammatic view of the projection apparatus for printing motion picture film in accordance with my invention. Fig. 2 is a diagram of a modification thereof. Fig. 3 shows actuating means for the part of the optical system controlling magnification and Fig. 4 shows actuating means for the part of the optical system controlling registration.

Similar reference characters indicate the same parts throughout.

The essential features of my invention are shown in Fig. 1. A film 10 carrying a series of complementary color images is intermittently drawn past film gates or windows 11 and 12 by suitable pull down claws 13 and 14 respectively which are actuated in a well known manner and may be mechanically interlocked for simultaneous operation by a rod 15 through gears 16 and the shafts 17 and 18. The windows 11 and 12 are provided with openings 19 of a size to accommodate two frames of the images on the film 10.

The printing takes place at the lower window 12 behind which is positioned the usual printing lamp 20 and condenser lens 21. The light passing through the frames of the film 10 appearing in the window 12 is imaged by suitable projection lenses upon the corresponding frames of the positive film 22 behind the gate 23 having an opening 24. The upper frame in the window 12 is projected by lenses 25 and 26 onto the upper frame of the positive 22 appearing at the gate 23 and the lower frame in the window 12 is projected on to the lower frame of the positive 22 in the gate 23 by the lens unit 27. In order to prevent confusion between the two beams of

light, a partition 28 is provided. A shutter 29 adapted to operate synchronously with the pull down 14 is mounted on a shaft 30 and is rotated through the bevel gears 31 and 32, the latter turning with the shaft 15.

The mechanism thus far described is designed to advance the films 10 and 22 by the width of two picture frames at each operation. The shutter 29 is also designed to operate in proper synchronism with the film advancing means.

A low wattage lamp 33 furnishes light to the two frames of the film 10 in the window 11 and these frames are imaged in superposed relation on a viewing screen 34 by a suitable optical system now to be described.

A lens 35 having a focal length equal to its distance from the picture frame A passes parallel light to its associated lens 36 which images the frame A on the screen 34. A lens unit 37 is positioned to image the frame B on the screen 34 and the two images are superposed by any well known device such as a beam splitter 38. The lens 36 is fixed in position and the lens 35 is adapted to be moved up and down and sidewise in its own plane to properly register the two images on the screen 34. The lens unit 37 is movable only along its axis and by such movement the magnification of the two images on the screen 24 can be matched. When the registry and magnification of the images have been accurately matched, the optical system will have been adjusted to correct for any errors in the pictures on the negative film 10 due to the above mentioned causes. It has been found that any errors in the negative are uniform for any one scene taken at one time and therefore if similar adjustments are made in the printing optical system as have been made in the viewing optical system, printing images on the film 22 will be accurately located and of proper size when the viewed images on the screen 34 are correctly matched.

The printing optical system is similar to the viewing system just described and comprises a fixed lens 26 and a lens 25 movable in its own plane for projecting the picture frame A′ and a lens unit 27 for projecting the picture frame B′. Any suitable partition 28 separates the optical projecting system. As in the viewing system, the lens 25 has a focal length equal to its distance from the plane of the film 10 and is movable vertically and horizontally in a plane perpendicular to its axis for adjusting the relative locations of the two printing images C′ and D′ on the film 22. With this arrangement it is obvious that the image C′ may be adjusted to bring any given point of the image into a position relative to the sprocket perforations of the film 22, or any other point of reference, occupied by the corresponding point in the image D′. The lens unit 27 is movable along its axis for adjusting the magnification of the image D′ to bring it to the same size as the image C′.

One suitable arrangement for moving the lens units 27 and 37 in assembly is shown in Fig. 3 as comprising a carriage 40 carrying bent arms 41 and 42 upon which are mounted the lens units 27 and 37 respectively. The carriage 40 is slidably mounted upon rods 43 secured to standards 44 and 45 which are rigidly mounted on the printing machine in any suitable manner. A rod 46 journaled in the standard 45 has a threaded engagement with the carriage 40 and upon turning it by means of the knob 47 the carriage 40 will be moved along the length of the rods 43. From this it will be seen that after initial adjustment of the apparatus, the movement of the lens unit 37 for varying the magnification of the visual image on the screen 34 will be duplicated by the lens unit 27 and the size of the printing image B′ will be varied accordingly.

In Fig. 4 is shown one arrangement for moving the lenses 25 and 35 in assembly for correspondingly adjusting the location of the images C and C′. The lenses 25 and 35 in suitable mounts are carried by arms 48 and 49 mounted on a carriage 50. The carriage 50 is slidable along a track 51 mounted on a carriage 56 and provided with a rack 52 and may be moved by means of a pinion 53 operated by hand wheel 54 to adjust the lenses 25 and 35 in a horizontal direction. By a similar structure vertical adjustment is secured relative to a bracket 55, adapted to be mounted on the top of the printing machine, by movement of a carriage 56 by a rack 57 and a pinion 58 operated by hand wheel 59. It is now seen that after initial adjustment of the apparatus the movement of the lens 35, necessary for securing registration of the viewing images on the screen 34 will be duplicated by the lens 25 and when the viewed images C and D are accurately registered, the images C′ and D′ on the film 22 will be properly located.

It is to be noted that the arms carrying the two systems of lenses are oppositely bent so as to permit free movement of each system.

In Fig. 2 is diagrammatically shown one modification of my invention. For superposing the viewing images C and D on the screen 34, the beam splitter 38 shown in Fig. 1 may be replaced by a collimating lens 60 in which case the lens unit 37 may comprise a single lens. In order to aid the operator in the registering of the images on the screen, color filters 61 and 62 may be positioned in the optical paths between the picture images A and B and the collimating lens 60 or the beam splitter 38 if the arrangement shown in Fig. 1 is used. Any lack of registry in the superposed images on the screen 34 will be very easily perceptible in the form of color fringes.

It has been found in practice that adjust-

ment of registration need only be made when the scene on the negative changes, and the adjustment necessary is generally so small that any lack of accurate registration of the two or three composite frames appearing in the loop of the film 10 between the gates 11 and 12 will not be detrimental since any such inaccuracy will appear only at the end of a scene.

In operating the printer of my invention, the use of a low power lamp 33 allows any amount of time for initial registration without danger of injury to the film after which the printing lamp 20 may be lighted and the film moving mechanism actuated. In many cases the operator will be able to register the images when a new scene starts without interrupting the printing operation and where more time is needed for image registration it will be a simple matter to stop the apparatus for the short period necessary.

Since mechanical details would merely complicate the figures unnecessarily and as they are immaterial, they have not been shown here. It is to be understood that any suitable means may be employed for handling the film and for mounting the essential elements of my invention. One suitable form of apparatus is illustrated and described in Patent No. 1,361,012 to Captstaff.

It will be obvious that apparatus made in accordance with my invention may be utilized for printing on double coated film by incorporating in the optical system a suitable light bending system.

It is thus apparent that I have invented a machine in which proper registry of the images is obtained by registering superposed images on a screen and due to the relative large size of the images on the screen and the fact that they are real images rather than virtual images, accurate registration is readily accomplished. I contemplate as within the scope of my invention as defined in the appended claims all such mechanical and optical equivalents as will perform the function specified.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a photographic apparatus the combination of a first projection window and a first optical system, a screen positioned to receive rays from the first optical system, a second projection window and a second optical system, a printing gate positioned to receive rays from the second optical system, means for adjusting the first optical system to properly register the rays on the screen and connecting means for simultaneously and correspondingly adjusting the second optical system.

2. In apparatus for printing two picture frames of a negative on a positive in proper size and in proper spaced relation, the combination of means for locating the frames successively in two predetermined positions, a lamp, an optical system and a screen associated with the first position for projecting the two frames on the screen in superposed relation, a printing gate, a lamp and an optical system associated with the second position for projecting the frames on the printing gate in spaced relation, and means for adjusting the two optical systems in assembly.

3. In photographic apparatus for printing two color separation images of the same view in accurate spaced relation on a positive comprising in combination a viewing screen and a printing gate, projection windows located in predetermined relation to the screen and to the gate, a first optical system associated with one of the windows and the screen and adjustable to project the two images in the window on to the screen in registered superposed relation, a second optical system associated with the other of the windows and the gate and adjustable to project the two images in the last mentioned window on to the gate in registered spaced relation, and means for adjusting both of said optical systems in assembly, whereby registration of the images on the screen assures registration of the images at the printing gate.

4. In apparatus of the kind described, means for feeding a continuous strip of film carrying two alternating series of color records successively past two windows, an optical system associated with one window for projecting one record of both series on a screen in superposed relation, an exposure gate, means for feeding sensitized film past the gate, an optical system associated with the other window for projecting upon said gate simultaneously and in spaced relation one record of both series, unitary means for adjusting the optical system to vary the magnification of one of the images on the screen and on the gate and independent unitary means for adjusting the optical system to vary the location of the other of the images on the screen and on the exposure gate.

5. In an apparatus for printing a positive film from a negative film having a pair of spaced records, in combination, a negative film support having two projection gates each of which is adapted to hold a pair of records, a screen and a positive film gate, optical projection means between one of the projection gates and the screen for superposing images of a pair of records on said screen, optical means between the other of the projection gates and the screen for superposing images of a pair of records on said screen, optical means between the other of the projection gates and the positive film gate for projecting images of the records in said other gate on the positive film gate, means for adjusting said optical projection means to accurately register said superposed images and connecting means for simultaneously adjusting the opti-

cal means between the projection gate and the positive film gate, whereby accurate registration of the superposed images produces accurate location of the images on said positive film.

6. In apparatus of the kind described, a first window and a second window, means for holding two complemental records in the first window, a screen, optical means for projecting images of the two records on the screen in superposed relation, means for moving said records to the second window, an exposure gate, and a second optical system for projecting images of said records in spaced relation on said gate, the two optical systems being adjustable in assembly.

Signed at Rochester, New York, this 31st day of August 1931.

FORDYCE TUTTLE.