Oct. 12, 1943. A. C. BLANEY 2,331,451

FILM INSPECTION AND PRINTING SYSTEM

Filed Aug. 24, 1940 2 Sheets-Sheet 1

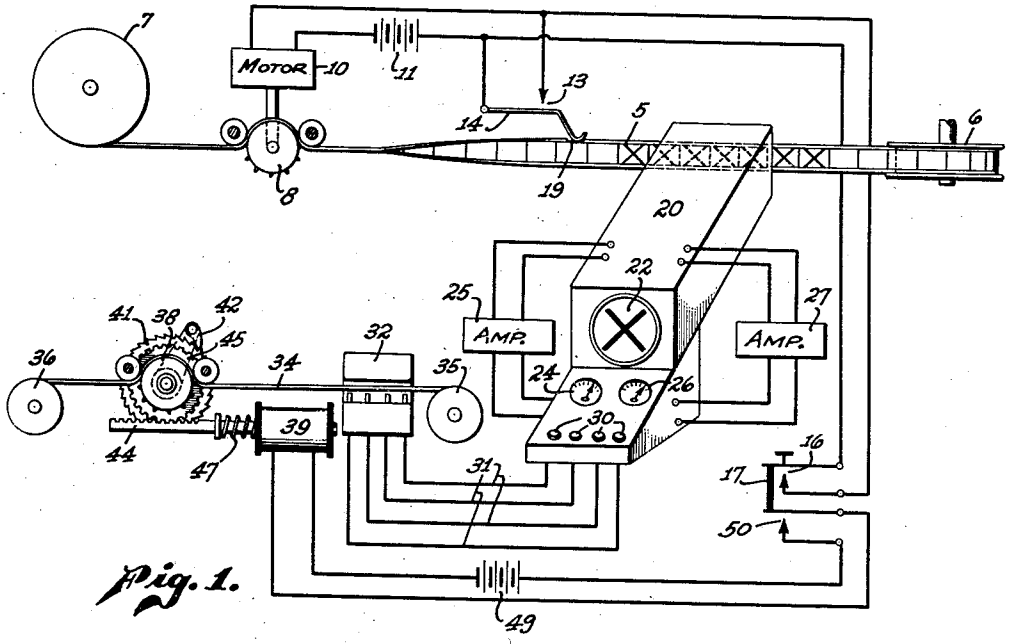
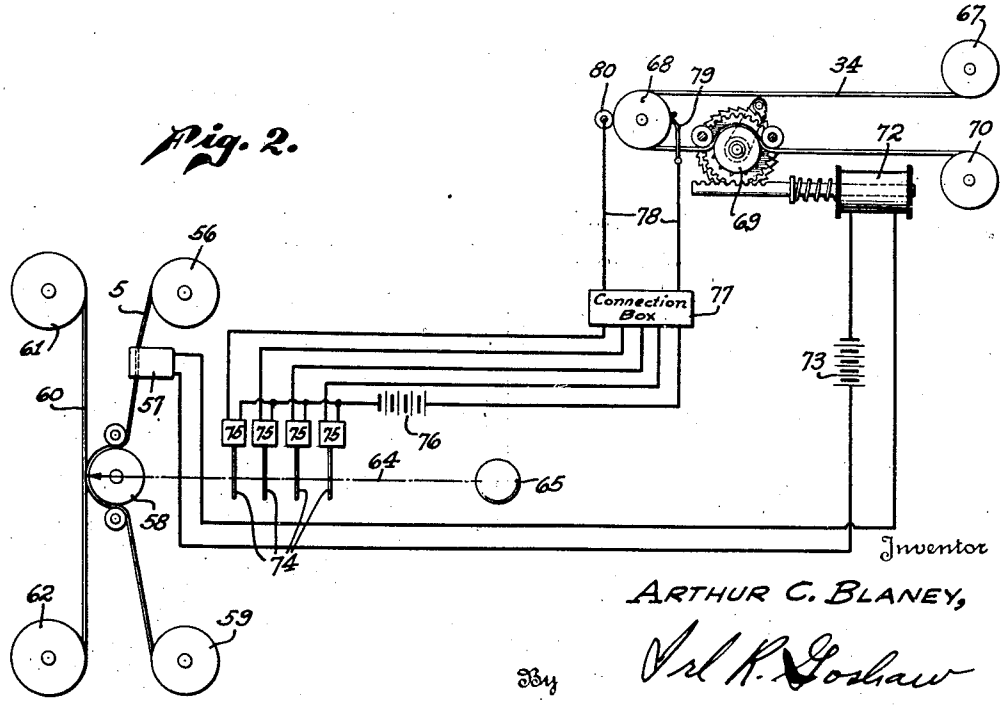


Fig. 1.

Fig. 2.



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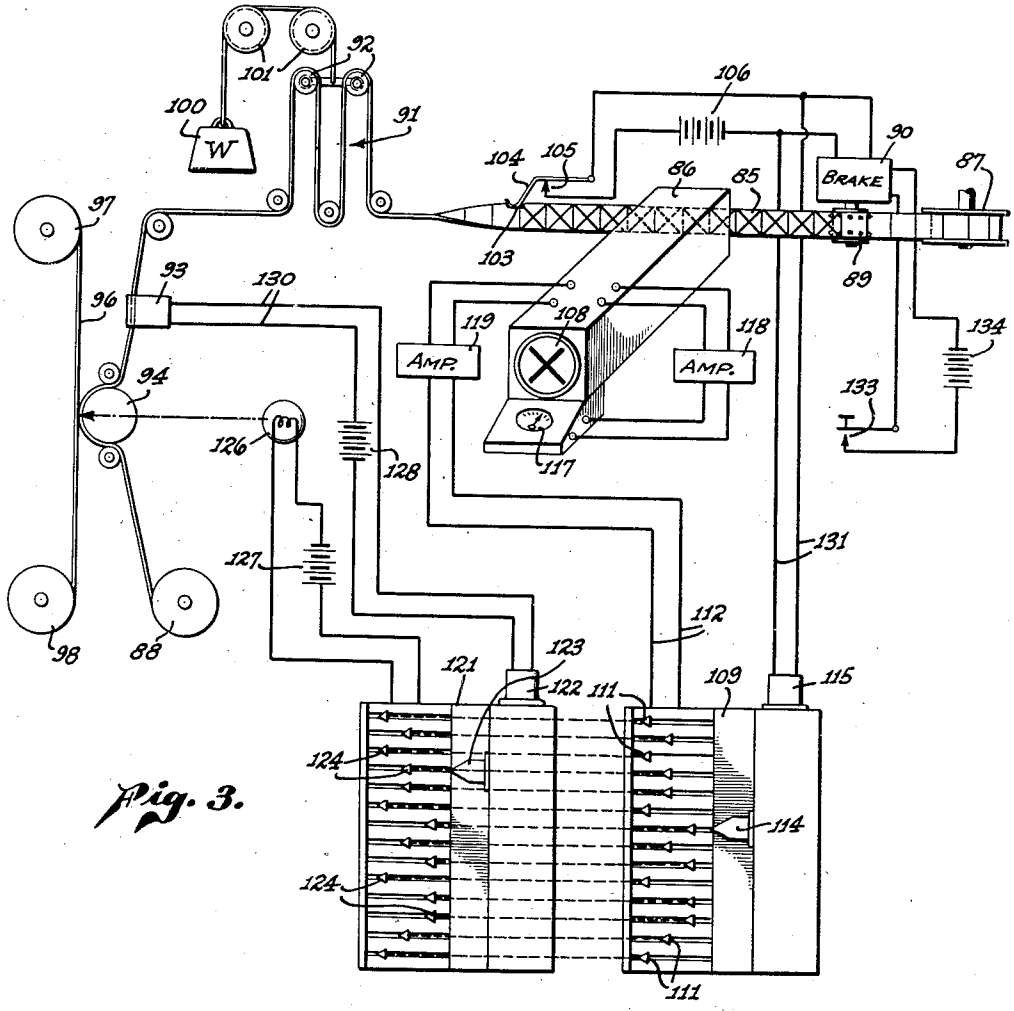


Fig. 3.

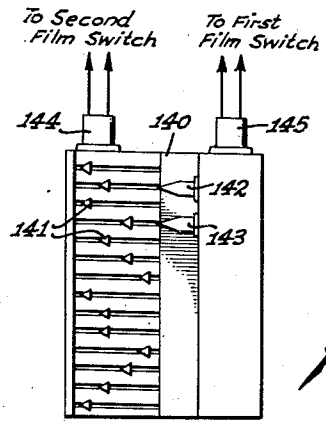


Fig. 5.

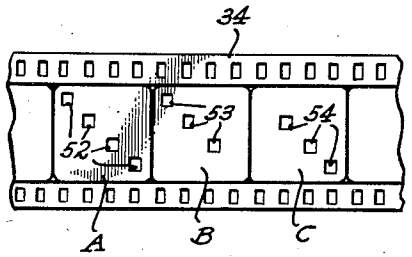


Fig. 4.

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UNITED STATES PATENT OFFICE

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FILM INSPECTION AND PRINTING SYSTEM

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Application August 24, 1940, Serial No. 353,992

17 Claims. (Cl. 95—75)

This invention relates to motion picture apparatus and particularly to apparatus employed in the intermediate process of printing motion picture film.

It is well known in the art of a motion picture production that the final picture includes a large number of picture and sound sequences photographed and recorded at different times. The final positive prints are made from a series of negative sequences spliced together to form reels or rolls . Since these negative sequences are made under various light conditions and with different cameras and recorders, it is generally true that the average light transmission varies from sequence to sequence of the negative reel. In the process of printing, the positive print may be given a uniform light transmission by varying the printing light in accordance with the light transmission variations in the negative. This is also desirable in the printing of sound tracks of a type which lend themselves to this treatment since the average sound level is thus made constant.

At present, the process of varying the printing light according to the photographic density of the negative sequences has been accomplished by first determining the average density of each sequence, then noting on a cue sheet the light intensity required to properly print the particular sequence, and finally adjusting the printing light to the required intensity during the printing operation. The step of determining the average density of each sequence involves the actual printing of a test strip of several frames of each sequence at different light intensities and then inspecting these test strips for quality. The best light intensity is thus chosen and marked on the cue sheet. The negative is generally notched near each splice when the scenes are spliced together, and as the notch passes through a film-operated switch, the light source is increased or decreased in intensity according to the difference in density between the succeeding sequencies. The variations in the light source may be accomplished by the insertion of resistances in the energy supply for the printing lamp or by varying the aperture between the light source and the negative film.

In modern printing laboratories where printing speeds are between 90 and 180 ft. per minute, automatic light adjusting means are employed. Such systems require the making of the test strip and its inspection to determine the correct exposure of the various sequences and then the punching of a control film which, when run in synchronism with the negative or in step with the sequences therein, automatically varies the light source. This practice, however, requires making the printing tests and the personal inspection of these test strips by an experienced operator, and any errors in his judgment are reflected in the printed positive.

The present invention is directed to a printing system which permits an operator to instantly view the negative as an enlarged positive and to permit him to vary the brightness of the reproduced positive to obtain the optimum value of density suitable for the particular scene being depicted. The operator may also vary the contrast of the reproduced positive so as to permit him to obtain the proper light exposure and developing time for enhancing the dramatic effect of the scenes. The system may be operated by first inspecting the negative and punching a control film in accordance with the desired light values required, or the system may be continuous, wherein the operator may inspect the sequences during the printing operation. The invention thereby eliminates considerable time and guess work on the part of the inspector by permitting him to preview the negative as it will appear after the positive raw stock has been printed and processed.

The principal object of the invention, therefore, is to facilitate the printing of motion picture film.

Another object of the invention is to facilitate the testing of a negative to determine the optimum printing exposure required.

A further object of the invention is to facilitate the punching of a printer control film for controlling the printer exposure light.

A further object of the invention is to transpose the negative scene into a positive before the printing operation.

A further object of the invention is to instantly create the negative scene as a positive scene and to vary the brightness and contrast of the positive to the optimum values.

A further object of the invention is to provide a continuous automatic printing system whereby the negative is inspected as a positive during the printing operation.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in

conjunction with the accompanying drawings forming a part thereof in which

Figure 1 is a diagrammatic arrangement of a negative film inspection apparatus embodying the invention;

Figure 2 is a diagrammatic view of a printing system operating with a control film made with the system of Fig. 1;

Figure 3 is a diagrammatic view of a continuous inspection and printing system embodying the invention;

Figure 4 is a fragmentary view of a control film; and

Figure 5 is a detailed view of a modification of the printer light control shown in Fig. 3.

Referring now to Fig. 1, a negative film 5 comprising a series of various sequences of different densities is shown being supplied from a reel 6 and taken up by a reel 7, the film being advanced by a sprocket 8, preferably intermittent, driven by a motor 10 energized from any suitable source, such as represented by a battery 11. The motor 10 is under control of a contact 13 of a film-operated switch 14 and a contact 16 of a manually operated switch 17. As mentioned above, the negative film, generally at the time of splicing, is punched at the beginning or end of each sequence, such as shown by the notch 19 in film 5. As the switch 14 rides along the film, the contact 13 is maintained closed and the motor 10 advances the film 5. When the switch 14 drops into the notch 19, the contact 13 is broken and the motor stops, thus stopping the movement of the film. When it is desired to further advance the film 5, the switch 17 is operated, closing contact 16, which starts the motor sufficiently to operate switch 14 and close contact 13. The switch 16 may then be opened and the negative film 5 will continue to advance.

The negative film 5 is advanced in front of an electron camera 20 which may be a television transmitter-and-receiver unit made up of an iconoscope-and-kinescope combination. As the negative passes one end of the camera 20, a positive image thereof is created on the fluorescent screen of the kinescope as shown at 22. This positive image may be much larger than the negative picture for better and quicker inspection. A dial 24 on the control panel of the camera permits the operator to vary the brightness of the image produced at 22 through the circuit including an amplifier 25, while a dial 26 permits the operator to vary the contrast of the image 22 through the circuit including an amplifier 27. Various brightness and contrast control circuits are well known in the art, one type being disclosed in U. S. Patent 2,124,394 of July 19, 1938. One method of controlling brightness of the image is by linearly varying the potential on one of the kinescope electrodes to vary the speed of the electrons while contrast is controlled by varying the point of modulation along the curved portion of the characteristic of one of the amplifiers as described in the above patent.

Also located on the control panel of the camera 20 is a plurality of switch buttons, four of which are shown at 30. These buttons are connected by respective conductors 31 to a solenoid operated punching device 32. Running through the punch 32 is a contrfol strip or film 34 fed from a reel 35 and taken up by a reel 36. The film 34 is advanced by a sprocket 38 which is operated by a solenoid 39 through a pawl-and-ratchet assembly having a ratchet wheel 41 and a pawl 42. The armature of the solenoid 39 is in the form of a rack 44 which meshes with a pinion gear 45. Thus, upon energization of the solenoid 39, the rack 44 is pulled to the right, rotating the gear 45 which rotates the ratchet 41 in a counter-clockwise direction. Since the pawl 42 is keyed to the sprocket 38, the sprocket will be rotated sufficiently to advance the film 34 one frame. Upon deenergization, a spring 47 returns the rack 44 to its normal position, rotation of the ratchet 41 in a clockwise direction not producing any movement of the pawl 42.

The solenoid is energized from any suitable source of power, such as a battery 49 upon the closing of contact 50 of the manual switch 17. Thus, when it is desired to advance the film 34 one frame, it is only necessary to close contact 50, and the film will be so advanced.

The operation of the above system will now be explained. The negative film 5 is threaded between the reels 6 and 7, and the motor 10 is started by closing switch 17 after a control film 34 has been threaded between the reels 35 and 36. When the first sequence notch such as notch 19 reaches switch 14, the negative will be stopped and the inspector may then view a negative picture in the sequence as reproduced at 22 in positive light values. If the positive image does not appear in the proper brightness, the operator may vary the density or brightness of the image by his dial 24. The dial 24 is calibrated in printing exposure intensity so that the inspector-operator will know what value of exposure light is required to produce the same quality of the positive film print. He then presses one or more of the keys 30 in accordance with the exposure required, and certain holes will be punched in the film 34 as shown in Fig. 4. In this figure, three frames of a control film are shown to illustrate three different exposure light values. There are four holes 52 in frame A; three holes 53 in frame B; and three holes 54 in frame C, but differently arranged than in frame B. Thus, each combination of holes will, as will be explained hereinafter, produce a particular printing light exposure.

Although the brightness control is generally sufficient to determine the proper printing exposure for the average scene, it is sometimes desirable to vary the contrast of certain portions of a scene to bring out certain details thereof. To determine what the developing time should be to accomplish this result, the operator may vary dial 26 to change the contrast of the image. This will enhance the dramatic effect of the scene.

After the film 34 has been punched and it is desired to move to the next sequence, the operator simply closes switch 17 which starts the motor 10, as described above, and also advances the film 34 one frame by closing contact 50. The motor will then continue to advance the negative until the next film notch is encountered by the switch 14 which, of course, will be the next sequence to be inspected. Thus, the inspector is provided with a system for accurately testing and inspecting a negative film and for quickly cueing a control film, the system providing a method of previewing the negative film as it will appear after the printing step has been completed.

Referring now to Fig. 2, in which the printing operation is shown, the negative film 5 is supplied from a reel 56 which passes through a film contact switch 57 well known in the art, around a printing drum 58 and to a takeup reel 59. Posi-

tive film stock 60 is supplied from a reel 61 and taken up by a reel 62 in any well known manner, the positive film stock 60 and negative film 5 contacting at the translation point shown by the ray line 64 from a light source 65.

The control film 34 is supplied from a reel 67 around a roller 68 over a drive sprocket 69 to a takeup reel 70. The sprocket 69 is driven intermittently one frame length upon each energization of a solenoid 72 in the same manner as shown in Fig. 1 by the relay 39. The pawl-and-ratchet mechanism is the same as shown in Fig. 1 and will therefore not be further described. The solenoid 72 is energized from a battery 73 upon the closing of its circuit at film switch 57 in a manner similar to that shown in Fig. 1 by switch 14. Furthermore, the same film notches represented by notch 19 may be utilized to actuate the relay 72 in the printing operation.

The amount of light passing to the negative 5 from the lamp 65 is under control of a series of aperture or mask plates 74 having different-sized apertures. Each aperture plate or mask 74 is under control of one of several solenoids 75 energized from a suitable source of power, such as a battery 76. The solenoids 75 are connected through a connection box 77 to film-controlled switches, one circuit of which is shown as including a spring 79, a roller 68, a roller 80 and conductors 78. The roller 80 bears upon the film 34 as it passes over the metallic roller 68, and whenever one of the holes 52, 53 or 54 is immediately under the roller, the roller will contact the film roller 68 and a circuit will be made to the respective solenoid 75 through spring contact 79. Although only one film switch circuit is shown, it is to be understood that any number may be arranged in accordance with the number of holes punched in the film, while other types of impulse generators may be employed. Thus, as each frame is advanced around the roller 68, the aperture masks 74 will be adjusted to vary the light passing from the lamp 65 to the negative 5 in accordance with the punches therein.

From the above description of Figs. 1 and 2, it will be observed that a two-step printing system is disclosed whereby a control film may be accurately cued and later used to control the light exposure during the subsequent printing operation.

Referring now to Fig. 3, a continuous printing system is disclosed wherein the use of a light control film is eliminated. In this system a negative 85 passes in front of an electron camera 86 of the type shown in Fig. 1 from a reel 87 to a takeup reel 88, the negative film passing over a sprocket 89 controlled by a brake 90 through a film elevator 91 having movable rollers 92, through a film switch 93 and over a printing sprocket or drum 94. The positive film 96 is advanced in contact with the negative 85 from a supply reel 97 to a takeup reel 98. The negative film 85 is maintained in taut loops around the elevator rollers by a movable weight 100 connected to the support for rollers 92 over idler rollers 101.

In the present system the negative 85 is advanced by the printer driving sprockets in any well known manner, the film passing the camera 86 at the normal printing speed. However, when a notch, such as shown at 103, is encountered by a switch 104, contact is made at 105. The making of this contact energizes the brake 90 through the battery 106 which stops the sprocket 89 and, thus, the negative film in front of the camera 86. During this stop period, the inspector-operator will make his adjustments to determine the printing exposure required. However, instead of the brightness dial being on the control panel as at 24 in Fig. 1, it is now in a control board 109 wherein a plurality of sliders 111 are adjustable to control the resistance between the conductors 112. This control board has a dropping contact device 114 under control of an impulse relay 115 so that each impulse supplied to the relay will release the contact device 114 and let it drop and connect conductors 112 through an amount of resistance determined by the setting of the respective sliders 111. The relay is energized over conductors 131 from film switch 104.

The conductors 112 are connected to the kinescope portion of the camera 86 through amplifier 119, and variations of the particular slider connected across conductors 112 will vary the brightness of the image at 108 as described in the above-identified patent disclosure. The operator thus varies the particular slider opposite the contactor 114 to control the brightness of the image at 108. The camera 86 is also supplied with a contrast control dial 117 connected in a circuit including amplifier 118, similar to the dial 26 and amplifier 27 of Fig. 1.

In addition to the control board 109 there is also provided a duplicate control board 121 having a relay 122, a contactor 123 and a plurality of sliders 124. Connected through the resistance values controlled by the position of sliders 124 is the energy supply 127 for the lamp 126. The contactor 123 connects the lamp 126 through battery 127 in series with a certain amount of resistance determined by the position of the sliders 124 as the contactor 123 is dropped by impulses arriving at the relay 122. Impulses are impressed on the relay 122 over conductors 130 from an energy source 128 under control of the film contact switch 93. The switch 93 is actuated by the notches in the negative, such as represented at 103. The contactor 114 of control board 109 is dropped by relay 115 when energized over conductors 131 from battery 106 when contact 105 is actuated by the notch.

It will be noted that not only are control boards 109 and 121 similar, but that the corresponding sliders on each control board are mechanically connected, as shown by the broken lines, so that when the operator moves any one of the sliders 111 on board 109, the corresponding slider 124 is also adjusted. Thus, the adjustment of one of the sliders 111, in accordance with the density of a certain sequence stopped by a notch like 103, will likewise be made on the corresponding slider of sliders 124 so that when notch 103 reaches switch 93, the intensity of the light source 126 will be in accordance with the adjustment of the slider on board 109.

The operation of the above continuous inspection and printing system will now be explained. After the negative film and positive film stock are threaded through the printing machine, the printer is started and the negative is advanced past the camera 86. When the first notch such as 103 arrives at the switch 104, the negative in front of the camera 86 will be stopped by operation of the brake 90. The printer, however, will continue to operate, taking its film from the elevator 91 by raising the weight 100. During this stopping period, the inspector varies the first slider of his board 109, which also varies

the first slider of board 121. When this is accomplished, the operator then closes manually-operated contact 133, which releases the brake 90 by energy supplied from a battery 130. The film then continues to be advanced and the elevator is again filled by the falling of weight 100.

When the notch 103 arrives at the film switch 93, the contact 123 will be dropped to the first slider adjustment and the lamp 126 will have an intensity for properly printing that particular sequence. The negative film continues to pass the camera 86 until the next notch is encountered, which again stops the negative for inspection. Simultaneously with the closing of contact 105, the relay 115 is energized from battery 106, and the contactor 114 of board 109 drops to the next resistance slider 111. The operator thus manipulates the second slider on board 109, which correspondingly adjusts the second slider on board 121 to prepare the board 121 for the next light exposure. By the use of the elevator system 91 and the mechanical interconnection of the sliders 111 and 124, the inspector may adjust board 121 in advance for three or four sequences. This is particularly desirable since printing speeds are up to as high as 180 ft. per minute and some sequences are only a few feet long. It is thus necessary to have a system in which the inspector may get ahead of the printer by three or four adjustments to give him time to make the necessary inspection of the shorter sequences in the negative reel. This also provides sufficient time to permit contrast inspections if desired.

The present continuous printing system thus utilizes the iconoscope-kinescope combination for testing and inspecting a negative as an enlarged positive from both the brightness and contrast standpoints. It also eliminates the preparation and use of a control film, the test films, and associate control apparatus. The time required to make better prints is thus shortened.

Referring now to Fig. 5, a control board 140 is shown having sliders 141 and two contacting elements 142 and 143. This board also has two relays 144 and 145. Instead of the two boards 109 and 121 of Fig. 3, such a single control board 140 may be substituted by connecting relay 145 to the film switch 104 and connecting relay 144 to the film switch 93 of Fig. 3. The relay 145, corresponding to relay 115 of board 109, controls the contactor 143, corresponding to contactor 114, while the relay 144, corresponding to relay 122, controls the contactor 142, corresponding to contactor 123. Thus, the operator operates the slider opposite the contactor 143 in making his adjustments for brightness of the image at 108 and the contactor 142 picks up these adjustments as the film notches reach the film switch 93. Such a system thus utilizes a single resistance board instead of two boards as shown in Fig. 3.

The above iconoscope-kinescope combination has been described as providing a preview of the negative as an enlarged positive. Although ordinarily the combination would produce another negative, the kinescope connections are such as to shift the phase of the image 180° to produce a positive image. The size of this positive image is only limited by the size of the kinescope.

In the above description, the apparatus for projecting the negative images on the iconoscope mosaic has not been shown for the sake of clearness, such apparatus being well known in the art.

What I claim as my invention is:

1. In a film printing system the combination of means for instantaneously viewing negative images on a film as positive images, a source of light, positive film stock, means for maintaining said negative film and said positive film stock in contact, means for controlling the exposure of said positive film stock to said source of light as determined by the brightness of said positive images, and means for varying the brightness of said positive images, said means simultaneously adjusting said exposure controlling means.

2. A film printing system for printing a negative film to positive raw stock comprising a light source, means for printing said negative film to said positive raw stock with light from said source, means for viewing the images on said negative film as positive images before the printing thereof to said positive stock, and means for varying the brightness of said positive images and simultaneously adjusting the printing light intensity of said source.

3. A film printer in accordance with claim 2 in which said viewing means comprises an electron camera adapted to reproduce said negative images as positive images, and said last-mentioned means for varying the brightness of said positive images determines the printing light intensity required to produce similar positive images on said raw stock.

4. In a motion picture film test system, the combination of means for instantaneously viewing negative film images as positive images, a control film, means for cueing said control film in accordance with the variations made in the brightness of said positive image, means for automatically stopping said negative film at predetermined positions, means for advancing said control film a predetermined amount, and means for manually starting the advancement of said negative film while simultaneously energizing said control film advancing means.

5. In a continuous film printer adapted to print a negative film to positive film stock, means for continuously advancing said film at a printing point, means for controlling the advancing of said film prior to said printing point, electronic means for instantaneously creating the images on said negative film as positive images, manual means for varying the brightness of said positive images, and means for controlling the exposure of said positive film, said last-mentioned means being connected with said manual brightness varying means whereby variations made in the brightness of said positive images adjust said exposure varying means.

6. A continuous film printer in accordance with claim 5 in which said last-mentioned means comprises a plurality of adjustable resistance units adapted to be connected to said electronic means, and means provided for stopping said negative film at predetermined intervals prior to the printing point, said means connecting one of said resistance units to said electronic means.

7. A continuous testing and printing system for printing a negative film to a positive film stock comprising means for light exposing said positive film stock through said negative film, means for varying said light exposure, means for instantaneously reproducing during said light exposing the negative images on said negative film as positive images, means for varying the brightness of said positive images, and means for controlling

said exposure varying means by said brightness varying means.

8. A continuous testing and printing system in accordance with claim 7 in which said means for instantaneously reproducing the negative images as positive images comprises an iconoscope-kinescope combination adapted to reverse the light values of the scanned negative images.

9. A continuous testing and printing system in accordance with claim 7 in which said last-mentioned means comprises a pair of variable tapped resistance control boards, the resistances of one of said boards being connected to said brightness varying means and the resistances of said other board controlling said light exposure, corresponding taps of each of said boards being adapted to be adjusted simultaneously.

10. A continuous testing and printing system in accordance with claim 7 in which a variable tapped resistance board is provided, said board having a contact member actuated by modifications in said negative film when said modifications reach said positive image reproducing means, and a second contact member actuated by said modifications when said modifications substantially reach the light exposing point.

11. A negative film testing and cueing system comprising means for advancing a negative film consisting of a series of sequences of images of different average light densities, means for advancing a cue film one frame at a time, means for instantaneously reproducing the negative images on said negative film as positive images, means for automatically stopping said negative film as each sequence arrives at said positive image reproducing means, means for varying the brightness of said positive images of each sequence to the light intensity required for said positive images, means for cueing said cue film in accordance with the brightness variations made to said positive images, and means for simultaneously advancing said cue film one frame and starting the advance of said negative film.

12. A negative film testing system comprising means for advancing a negative film consisting of a series of sequences of images of different average light densities, means for instantaneously reproducing the negative images on said negative film as positive images, means for varying the brightness of said positive images of each sequence to the light intensity required for said positive images, and means for automatically stopping each of said sequences as it arrives at said positive image reproducing means.

13. A system for printing a series of negative film images to positive film stock comprising means for advancing said negative film and said positive film stock in contact, means for reproducing said negative images as positive images, said means including means for varying the quality of said positive images during the reproduction thereof, means for exposing said positive film stock to light through said negative film, means for varying the exposure of said positive film stock, and means under control of said quality varying means for adjusting said exposure-varying means in accordance with variations made in the quality of said positive images.

14. A system in accordance with claim 13 in which automatic means are provided for stopping said negative film advancing means at predetermined positions, and manual means are provided for starting said negative film advancing means independently of said positive film stock advancing means.

15. A negative film printing system comprising means for advancing a negative film consisting of a series of sequences of images of different light densities, means for advancing positive film stock in contact with said negative film, means for reproducing the negative images on said negative film as positive images for observation, means for varying the brightness of said positive images to an intensity required for the scene depicted by said positive images, means for controlling the exposure of said positive stock at the contact point of said films, and means under control of said brightness varying means for adjusting said exposure-controlling means.

16. A system comprising means for advancing a negative motion picture film consisting of a series of sequences of images of different light densities, means for reproducing the negative images on said negative film as positive images for observation, means for varying the brightness of said positive images to an intensity required for the scene depicted by said positive images, means adjustable in accordance with the variation made in the brightness of said positive images for determining a subsequent exposure of a positive film stock through said negative film, and means associated with said last-mentioned means for adjusting a light beam to a value which will expose said positive film stock through said negative images to produce positive images on said stock of the same quality as said reproduced positive images.

17. In a system for producing a record of the exposure of a positive film to a negative film consisting of a series of sequences of images of different light intensities, the combination of means for advancing a negative film, means for reproducing the negative images on said negative film as positive images for observation, means for varying the brightness of said positive images of each sequence to the light intensity required for the scene depicted by said positive images, means for producing a record of said variations in brightness to control the exposure of a positive film stock to light through said negative images, means for selecting the particular negative images to be reproduced as positive images, and means for simultaneously advancing said negative film and said record after said record has been made for each particular negative image.

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