

May 17, 1938.

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2,117,727

MEANS FOR CONTROLLING PRINTING LIGHTS

Filed Oct. 28, 1935

4 Sheets-Sheet 1

Fig. 1.

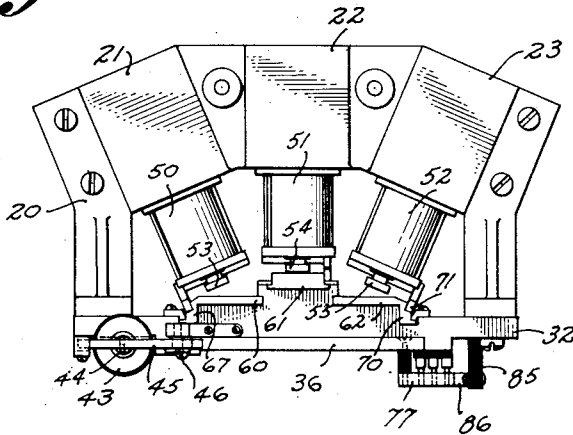
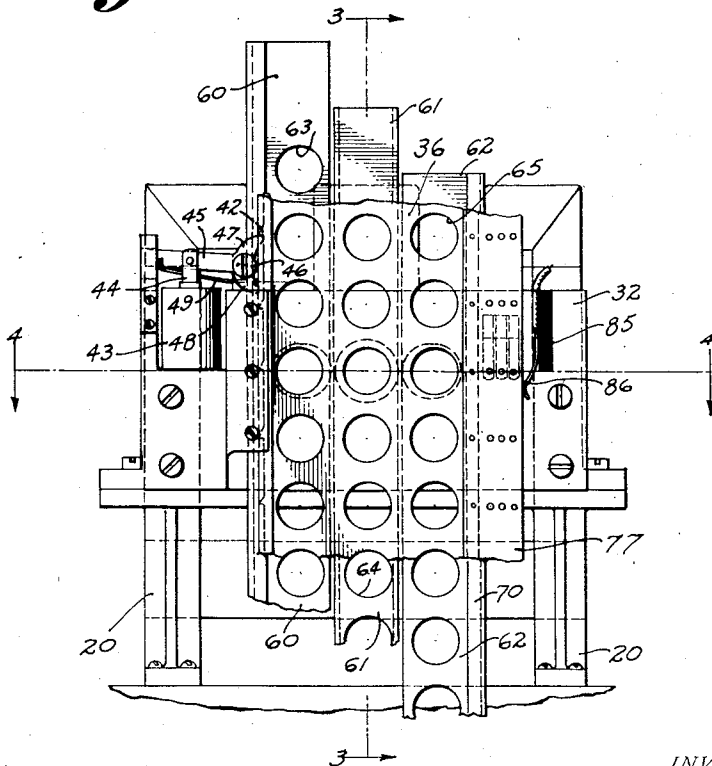


Fig. 2.



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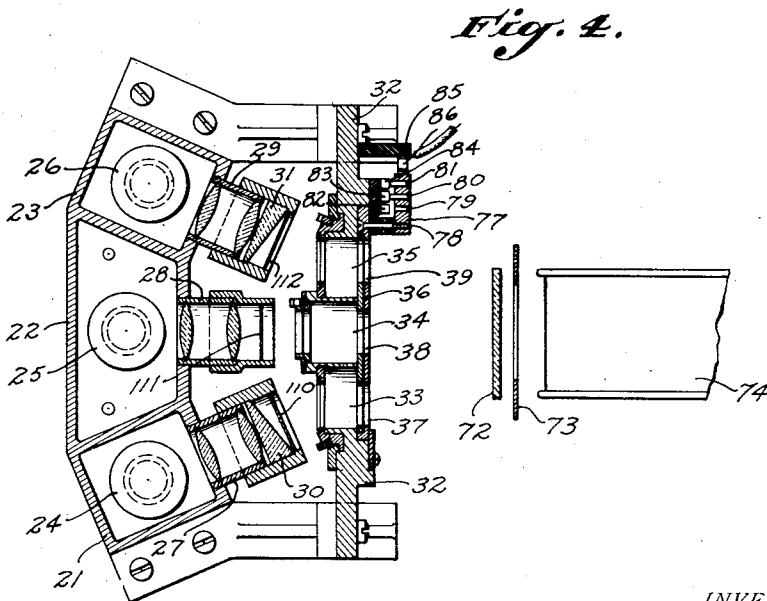
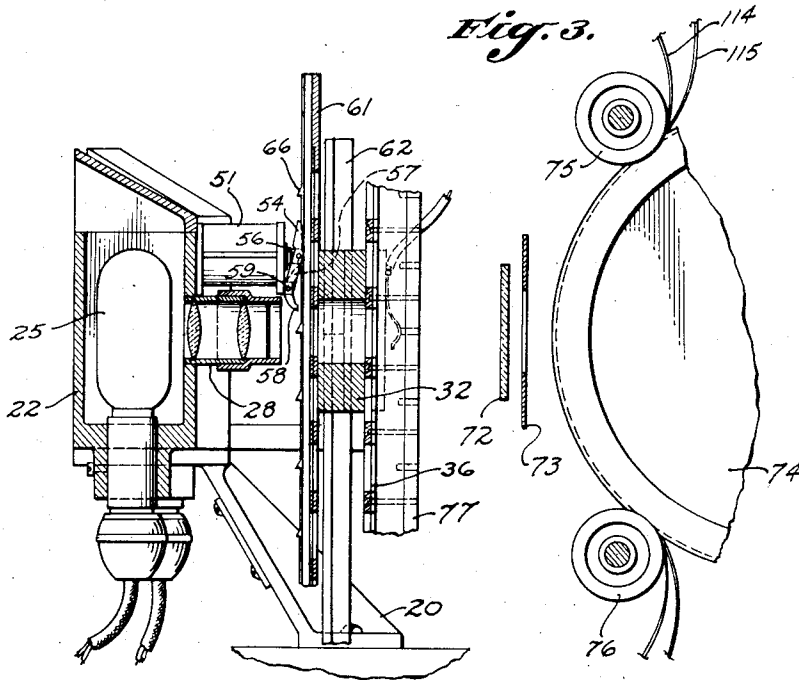
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

Fig. 5.

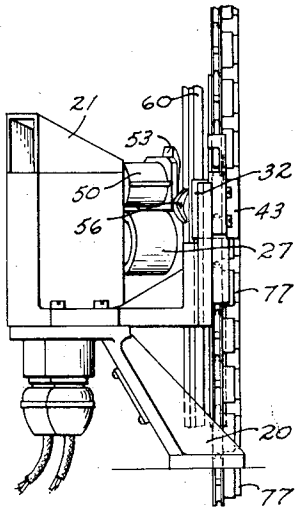


Fig. 6.

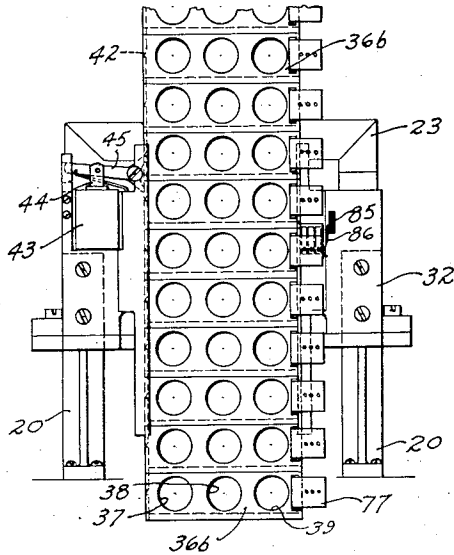


Fig. 7.

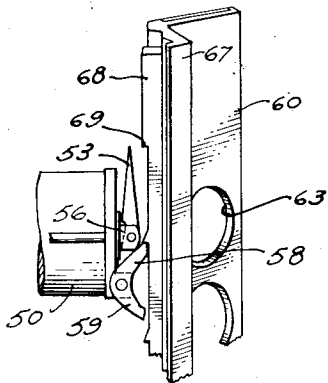


Fig. 8.

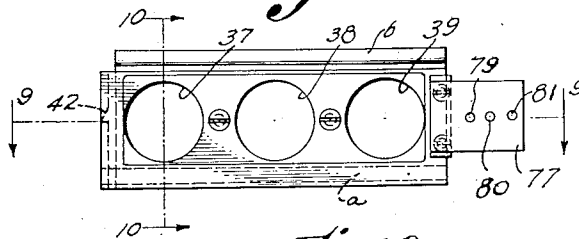


Fig. 9.

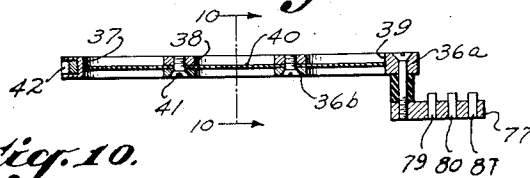
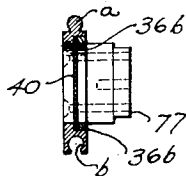


Fig. 10.



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Fig. 11.

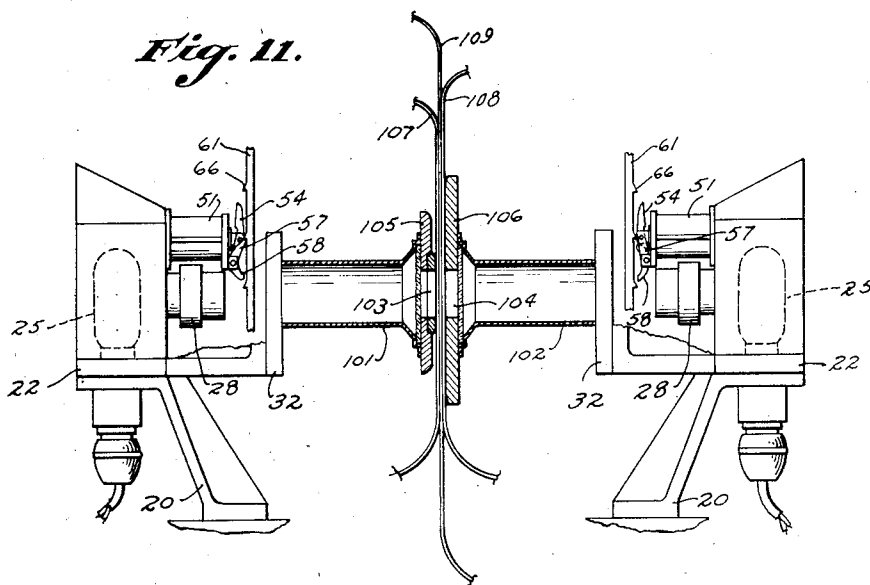


Fig. 12.

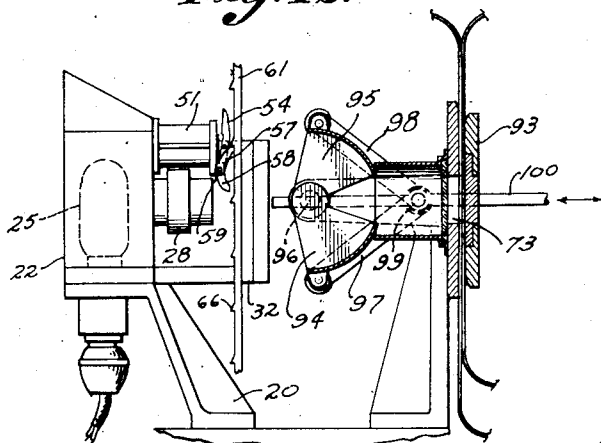
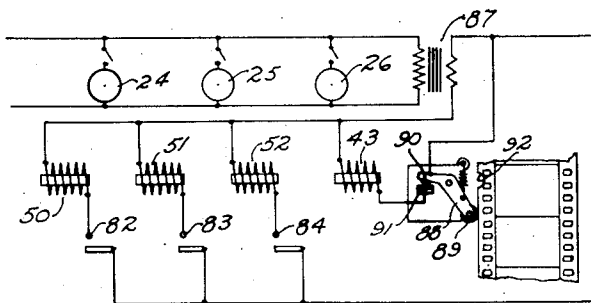


Fig. 13.



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UNITED STATES PATENT OFFICE

2,117,727

MEANS FOR CONTROLLING PRINTING LIGHTS

Charles F. Jones, Burlingame, Calif.

Application October 28, 1935, Serial No. 47,092

15 Claims. (Cl. 95-75)

My invention relates broadly to an apparatus for controlling printing lights in photography and to a novel means for accomplishing this having particular reference to motion picture production. My invention can be used with either continuous printers or with intermittent or "step" printers and is particularly valuable in connection with the printing of color films.

It has been quite general practice to vary the intensity of printing lights by varying the voltage of the light source and it is a major object of my invention to provide a means of varying the intensity of the light falling on the printing aperture without varying the voltage or intensity of the light source itself.

It is also an object of my invention to provide a means for varying the spectral range of the printing light as well as its intensity by means that are peculiarly well adapted to a printing operation employing a number of component light beams of different spectral ranges, as specified in my copending application, Serial No. 25,714, filed June 10, 1935, wherein a method of controlling color balance in printing is disclosed and claimed. When regulating and correcting color balance in motion picture film by the method set forth in my said copending application, it is essential to be able to vary the spectral range and intensity of the various component beams independently, and it is one of the objects of this invention to provide a simple and accurate means for so doing.

In printing motion picture film, it is of course advisable from a practical standpoint to make the light change from scene to scene automatic so that no time will be lost in the printing operation, and it is therefore an object of my invention to provide an apparatus for effecting automatic change of printing lights as needed and still maintain the intensity of the light source at a constant value.

It is a further object of my invention to provide a light control means which will give uniformly consistent results for all operations.

These and other objects and advantages of my invention will become apparent from the following description thereof and from the accompanying drawings in which:

Fig. 1 is a top plan view of a preferred form of my invention employing three lamp houses.

Fig. 2 is a front elevation of the form shown in Fig. 1.

Fig. 3 is a vertical section taken at 3-3 in Fig. 2 showing my invention with a continuous printer.

Fig. 4 is a horizontal section taken at 4-4 in Fig. 2.

Fig. 5 is a side elevation of the form shown in Fig. 1, but with a modified form of front filter plate.

Fig. 6 is a front elevation of the form shown in Fig. 5.

Fig. 7 is a detail in perspective of the latch-catch mechanism.

Fig. 8 is an enlarged front elevation of one segment of the modified form of filter plate shown in Figs. 5 and 6.

Fig. 9 is a horizontal section taken at 9-9 in Fig. 8.

Fig. 10 is a vertical section taken at 10-10 in Fig. 8.

Fig. 11 is a side elevation of a pair of lamp houses made according to my invention and disposed to simultaneously print two negatives from opposite sides to a single film.

Fig. 12 is a side elevation of a modified form for use with a continuous printer.

Fig. 13 is a wiring diagram of my preferred form.

Referring now to the drawings, I will first describe an embodiment of my invention adapted for use in the color control method of my said copending application. The numeral 20 indicates a suitable base and frame for supporting lamp houses 21, 22 and 23 of any convenient shape, said lamp houses being provided with lamps 24, 25 and 26 respectively. In the form shown using three lamp houses they are preferably arranged on a horizontal plane with the outside houses 21 and 23 being angularly positioned with respect to the center house 22. The lamp houses 21, 22 and 23 are provided with condensers 27, 28 and 29 respectively, and the outside angularly positioned houses 21 and 23 are also provided with prisms 30 and 31 respectively for partially straightening out the light rays of their respective lamps. It will be understood of course, that while I show and prefer to use a plurality of separate lamps, that one light source could be used to provide the plurality of light beams required in this form of my invention.

Disposed in front of said lamp houses is a vertical guide frame 32 which may be cast as a part of frame 20 or may be attached thereto by suitable means. Guide frame 32 is provided with an aperture opposite each lamp house, in this case three, said apertures being in the respective light paths and being designated by the numerals 33, 34 and 35. The front face of guide frame 32 is slightly recessed on each side to pro-

vide vertical slide grooves adapted to receive a vertically slidable filter plate 36 having a plurality of parallel sets of three openings or apertures, these openings being in a horizontal plane and designated by the numerals 37, 38 and 39. The plate 36 may be formed of two opposing plates 36a and 36b as shown in Fig. 9, adapted to have a filter 40 inserted therebetween, the plates being then secured together as by the screws 41 to give the composite plate 36. The arrangement of filters will be discussed in detail hereinafter.

One edge of the front filter plate 36 is provided with a series of spaced stop teeth 42 as seen best in Fig. 2 of the preferred form and Fig. 6 of the modified form, there being one tooth for each set of filter apertures. Adjacent the toothed edge of front filter plate 36 is a solenoid 43 mounted on the frame 20. The armature 44 of solenoid 43 is pin connected to the arm 45 of a latch-catch rocker pivoted on a pin 46 and provided with a latch 47 and a catch 48. The latch 47 is normally urged by a spring 49 against the edge of plate 36 so as to form a support for one of the teeth 42, the mechanism being so proportioned that when the solenoid 43 is energized the armature 44 depresses the arm 45 to move latch 47 out of engagement with its abutting tooth 42. This movement causes catch 48 to move in against the edge of plate 36 so that when the latter drops by gravity upon the release of latch 47, the tooth 42 will strike and be stopped by catch 48. When the solenoid 43 is then deenergized as will be explained in detail later, the catch 48 is released, allowing the plate 36 to again drop down until the next tooth 42 engages the latch 47 which has in the meantime resumed sliding contact with the edge of plate 36.

Referring again to Figs. 1 and 3, it will be seen that each lamp house is provided with a horizontal solenoid indicated by the numerals 50, 51 and 52 respectively, provided with armatures 53, 54 and 55. Each of these armatures is pin connected as at 56 to the arm of a latch 57 and catch 58 constructed as previously explained for latch catch 47-48. The respective latch-catches 57-58 are pivoted on pins 59 suitably carried by their respective solenoid housings.

The rear face of guide frame 32 is provided with three sets of vertical guideways, one in each optical path, in which separate vertically slidable filter plates 60, 61 and 62 are carried, each provided with a vertical series of holes or apertures 63, 64 and 65. The sidewalls of the guideways for plates 60 and 62 are parallel, but in offset planes and the sidewalls of the guideway for plate 61 are in the same plane as seen best in Fig. 1. The center filter plate 61 has one edge provided with teeth 66 similar to the teeth 42 on front plate 36. The outside edge of plate 60 as seen in Fig. 7 is provided with a vertically extending L-shaped rib 67 adapted to slide in the offset wall of its guideway. A vertical strip 68 secured to the central portion of rib 67 at an angle thereto is provided with a series of spaced teeth 69, there being a tooth opposite each of the apertures 63. Plate 62 is provided with a similar rib 70 and angular strip 71 provided with spaced teeth not shown. It will be apparent that as the solenoids 50 and 52 are angularly disposed with respect to solenoid 51, and plate 60, 61 and 62 are perpendicular to solenoid 51 that the above construction provides a very simple means for securing separate operation of the respective

single filter plates while at the same time providing a very compact structure.

The operation of the three latch-catch mechanisms 57-58 is similar to that previously explained for the latch-catch 47-48, the only difference being that as arms 53 are formed in a vertical position, they move horizontally instead of vertically as does arm 45. When the various solenoids are energized, the latches release, the plates fall and the catches engage their respective plate teeth, and when the solenoids are deenergized the catches are released, allowing the plates to fall until the latches engage the next above tooth of their respective plate.

As best seen from Fig. 4, the light rays from the various lamp houses are directed first through the coaxial aperture of their respective rear plates and then through the corresponding holes or apertures in guide frame 32 and front plate 36. The angular position of the respective light paths and the plates is such that the rays all converge at a convenient point in front of the front plate 36 as for instance on ground glass 72 placed behind a suitable exposure aperture 73. In Figs. 3 and 4 my device is shown as combined with a conventional type of continuous printer shown schematically as comprising a film carrying drum 74 with cooperating guide rollers 75 and 76 for leading the films 114 and 115 onto and away from the drum 74. As is well known in the art, the negative 114 and raw stock 115 are led past the printing aperture 73, to expose the raw stock through the negative, the amount of exposure being a function of the intensity of the light at the aperture and the time of exposure, which latter is a function of the drum speed and the aperture size. In practice the speed of drum 74 is kept constant and the amount of the exposure is controlled by varying the size of the aperture or the intensity of the printing light.

In producing commercial motion pictures one reel of edited and cut negative contains a number of scenes shot at different times and under different conditions. Consequently in printing these various scenes on a single reel of film it becomes necessary to regulate the density of each printed scene to get a general uniformity for the resultant print. Likewise where multicolored film is being printed according to the method of my said copending application it is essential that one be able to vary the wave length and/or the intensity of the various component light beams as well as the overall intensity of the composite beam. It is also desirable that these changes be made mechanically to eliminate loss of time.

In the form of my invention just described (using three light pencils) the overall intensity of the composite printing light formed by the convergence of the three light beams emanating from the light sources 24, 25 and 26 is controlled by the front filter plate 36. The required overall density for each scene is predetermined by any convenient means, numerous methods being well known in the art, and an appropriate neutral filter is placed across the three apertures 37, 38 and 39 to be used for printing that scene. These neutral filters can be made in a number of ways, but I prefer to make them photographically by exposing a strip of film either through a graduated wedge or by successive exposures of increasing time so that when the film is developed a series of silver deposits of gradually increasing density will be obtained. In operation the plate

36 is raised until its lowermost set of apertures is opposite the guide frame apertures 33, 34 and 35, these apertures being provided with the proper filter to print the first scene of the reel. The required filters for subsequent scenes are placed across succeeding sets of apertures in plate 36 and by means to be described in detail hereinafter the plate 36 is dropped successively at each scene change to interpose the required neutral filters in the three light paths. While I prefer to control the overall density of the print by a plate having three apertures, it will be understood of source that a single aperture plate disposed in the path of the merged beams could be used.

The relative intensity of each component beam is separately controlled in like manner by placing appropriate filters in successive apertures of the rear filter plates 60, 61 and 62, so that the individual intensities may be varied independently of one another and of the overall density control. Normally the spectral ranges of the three light sources 24, 25 and 26 will remain substantially unchanged for a given film or series of film, the wave length being determined either by the inherent range of the light source itself, or by colored filters such as 110, 111 and 112 placed in the condenser housing or other appropriate point in the separate optical paths. In this case neutral filters may be used in the rear plates 60, 61 and 62 for varying the intensity of the respective colored light beams. If, however, it is desired to change the wave length of the various component beams, as well as their intensity, colored filters of various densities are employed in the various holes of the respective rear plates, or differently colored equal density filters may be combined with neutral filters of different density. In this case the selected filter will control not only the intensity of the component beam, but also the spectral range of the beam, the individual filter plates being adapted to be dropped at each scene change if a different range and/or intensity is required for the new scene.

Referring now to Figs. 1 to 4, it will be seen that the front filter plate 36 carries an L-shaped longitudinal strip 77 along one edge, preferably the edge away from solenoid 43. One leg of strip 77 is of a non-conducting material such as bakelite, micarta, or the like and is suitably fastened to plate 36 as by screws 78. The other leg is made of conducting material and is parallel to the face of plate 36 extending laterally from the plate edge. The conductor leg of strip 77 is provided with a plurality of sets of three holes 79, 80 and 81 substantially on a line with the sets of apertures in plate 36. Each of the holes 79, 80 and 81 is adapted to have a plug inserted therein which is an electrical conductor, each plug being long enough to extend through its respective hole to contact an oppositely positioned spring contact or wiper carried by guide frame 32 and insulated therefrom. Three of these wipers 82, 83 and 84 are provided on the guide frame 32 in line with its apertures 33, 34 and 35 so that when the front plate 36 is at rest with its apertures coaxial with the guide frame aperture, plugs in the holes 79, 80 and 81 will engage their respective wipers 82, 83 and 84. Separate leads connect each wiper to one of the solenoids 50, 51 and 52 as shown by Fig. 13, the other terminal of each solenoid being connected to one side of a source of electrical energy 87.

An insulating block 85 mounted on guide frame 32 carries a wiper 86 adapted to slide along the edge of the conductor leg of strip 77 to at all times

maintain electrical contact through strip 77 with any plugs that may be inserted in holes 79, 80 and 81. The fixed end of wiper 86 is connected by appropriate conductors to one side of power source 87, thus making three parallel electrical circuits 5 with the three solenoids 50, 51 and 52.

Adjacent the film path as shown diagrammatically in Fig. 13 is a spring operated contact switch comprising a rocker 88 carrying a roller 89 on one end and a contact point 90 on its other end adapted to engage an opposing contact point 91. The negative being printed is notched at each scene change in conventional manner as shown at 92 so that the roller 89 which rides on the edge of the film will drop into the notch 92 just before a new scene is to be printed, thus moving the rocker point 90 into engagement with contact point 91 to close the circuit of solenoid 43.

The cycle of operations for effecting the printing light change is as follows. When the solenoid 43 is energized by the closing of contacts 90 and 91, its armature 44 is pulled down releasing the latch 47 from its engaging tooth 42 and throwing catch 48 up against the edge of plate 36. The plate 36 then drops down until tooth 42 meets the catch 48 and comes to rest. By this time the roller 89 has risen out of notch 92 breaking the connection between points 90 and 91 to deenergize solenoid 43. This allows armature 44 to be returned to its normal position by spring 49 which action releases catch 48 and moves latch 47 over against the edge of plate 36. The plate then drops the rest of the way to its new position with its next set of apertures opposite the guide frame apertures where the next tooth 42 engages latch 47.

If a change is to be effected in each of the component beams, a plug is inserted in each of the holes 79, 80 and 81 of the set next above the exposing apertures, so that when the plate 36 drops to its next position as just described each plug will engage its respective wiper 82, 83 and 84 to close the circuit of each of solenoids 50, 51 and 52 to operate their respective latch catch mechanisms in the manner just set forth, allowing the rear filter plates 60, 61 and 62 to drop one position to interpose the new filters in their respective light paths. In many cases one or more of the component light beams will be of the same range and intensity for two successive scenes and in this case the plug ordinarily inserted in its hole of the set 79, 80 and 81 is omitted so that when the plate 36 drops to its new position the circuit of that solenoid is kept open.

As previously mentioned the plate 36 is made of sufficient length to provide a set of apertures for each scene to be printed from a single reel of negative. In Figs. 5 and 6, I have shown an embodiment of my device employing a modified form of front filter plate 36. In this case the plate is comprised of a plurality of hinged segments, each provided with three holes or apertures 37, 38 and 39 as before, and each segment being adapted to have a filter 40 placed thereon. The hinge construction is best seen from Fig. 10 where it will be noted that the top edge "a" is provided with a rounded outer or head portion with restricted shanks to form the male end of the joint. The bottom edge "b" is provided with a complementary shaped recess to accommodate the male end of the next lower segment. The segments are assembled by slipping the male end of one segment in the female end of the other and sliding the segments laterally until they are lined up vertically. In operation as many seg-

ments are assembled in one series or chain as there are scene changes to be made, and as the segments are interchangeable it is advisable to have a number of segments on hand of the same filter density so that the filters in the individual segments need not be changed. Each segment is provided with a shoulder or stop tooth 42 on one side thereof which operates in conjunction with the latch catch mechanism 47—48 as previously described for the one piece plate 36. Also each segment carries on its other edge a segment of strip 77 with three plug holes therein for operating the rear filter plates as previously described.

In Fig. 12, I have shown a modified form of my invention for continuous printing with a variable slit wherein the amount of overall exposure is controlled by varying the time of exposure instead of the intensity of the light at the aperture as in the previous form. For simplicity, only one lamp house and filter plate assembly has been shown in this figure, but it will be understood of course, that a plurality of units may be combined as illustrated in Figs. 1 to 4, their respective beams being merged into one composite printing light and the overall density control being regulated by the variable slit mechanism shown. In this instance the apertured front plate 36 may be done away with entirely except as a means for operating the rear filter plate solenoid circuits, or if desired other suitable means may be supplied for causing the predetermined drops of the separate filter plates to vary the component beam intensities. Considering the assembly illustrated in Fig. 12 as being the center optical unit of Figs. 1 to 4 and applying the same numerals, we have a lamp house 22, a lamp 25, condenser 28, solenoid 51, armature 54, rear filter plate 61, with teeth 66, latch-catch mechanism 57—58 and guide frame 32, all supported on base 20. Further corresponding to the numbering heretofore used, a printing aperture 73 is shown with a backing plate 93 in place of the drum 74 of Fig. 1, it being understood of course, that a drum or other means could be employed with this type of construction to secure continuous motion of the film across the light path.

The variable slit mechanism shown in Fig. 12 for regulating the overall intensity of the printing lights is of substantially conventional design and comprises a pair of jaws 94 and 95 rotatable about a pivot point 96. A link mechanism comprising connecting links 97 and 98 pivotally connected to jaws 95 and 96 and pivotally connected at a common point by pin 99 to a horizontal rod 100 serves to open and close the jaws in response to the operation of a suitable circuit and mechanism (not shown) which responds to the action of roller 89 cooperating with notches 92. The operation of this form is similar to the operation of the preferred form except that the overall intensity of the composite printing beam is controlled by varying the size of the slit made by jaws 94 and 95, the filter plate latch-catch mechanisms being either operated independently or by a movable control strip, electromagnetically operated as in Figs. 1 to 4.

While my invention perhaps finds its most valuable application when used in connection with the method of color control disclosed in my said copending application, it also has a ready adaptability and value for printing color positives from two or more uncolored separate color value negatives. One form adapted for such use is shown in Fig. 11 where a double printer is diagrammatically illustrated which is adapted to simul-

taneously print two negatives from opposite sides to a positive film strip. The two optical units may be exact duplicates of one another and of the form illustrated in Fig. 12 (minus the variable slit mechanism) comprising frames 20, lamp houses 22, condensers 28, solenoids 51, sliding filter plates 61 with teeth 66, latch-catch mechanisms 57—58, armatures 54 and guide frames 32. Light tunnels 101 and 102 may be connected to the apertures of the respective guide frames 32, each leading to a double printing aperture formed by apertures 103 and 104 in aperture plates 105 and 106 respectively. Two negatives 107 and 108 each carrying complementary part images preferably registered by perforations at their respective camera apertures as disclosed in my copending application Serial No. 24,514, filed June 1, 1935 are advanced between the aperture plates 105 and 106 with a strip of positive raw stock 109 between them. The movement may be accomplished by any convenient means and is preferably intermittent or step to insure exact registry during the printing operation.

When using my invention for printing from uncolored negatives the spectral range of the printing light is immaterial except as indirectly affecting transmission efficiency and only neutral filters need be employed. A complete range of neutral filters may be prepared similar to the group used in front plate 36 of my multiple unit, and filters of appropriate density are placed in successive apertures of filter plate 61 depending on the density of the scene to be printed. The solenoid 51 may be operated directly from the contacts 90 and 91 of Fig. 13 as is the solenoid 43 in that figure. If two lamp houses and solenoids are used as illustrated in Fig. 11, they can both be operated from the same contacts by an obvious modification of the diagram in Fig. 13.

Varying the intensity of the light at the printing aperture without varying the intensity or the spectral range of the source is a decided improvement over existing methods, for it then becomes possible to secure exact uniformity in printing light settings. Where the intensity of the lamp itself is varied by changing the voltage, many variable factors enter into the picture, making it practically impossible to always secure exactly the same intensity at the aperture for the same theoretical setting. Furthermore, varying the voltage means varying the spectral range in most cases which is obviously undesirable. By my method, however, a plurality of filters can be provided which can easily be made exact duplicates of each other and every time a light of a given intensity is required a filter of exactly the same transmission is used and so long as the intensity of the source stays constant absolute accuracy can be obtained.

Another distinct advantage of my system lies in its speed and certainty of operation. The speed of the filter plate drop can be easily regulated by coordinating the plate weight and the throw of the solenoid armatures and when so determined ordinary care insures its maintenance at the fixed value. Furthermore, by employing a latch-catch mechanism as described absolute protection is given against the possibility of the solenoid failing to release rapidly enough when deenergized and allowing the filter plates to drop several positions which would of course throw all subsequent scenes out of balance.

It will be apparent to those skilled in the art that various combinations can be made of the forms shown herein and that modification

of various parts may be made by substitution of other parts of equivalent function and it is to be understood that the foregoing description and attached drawings are merely illustrative of what are now deemed preferred forms of my invention and are in no way meant as limiting the full scope thereof as defined by the appended claims.

I claim as my invention:

1. An apparatus for copying a series of photographic images carried by a film strip which includes: a light source; means for moving said film strip and a strip of light sensitive film across the path of rays emanating from said light source; movable plate means disposed in said light path between said film strips and said light source carrying a plurality of filters; a second movable plate means in said light path carrying a plurality of filters; and means carried by said first plate means for causing movement of said second plate means in response to movement of said first plate means.

2. An apparatus for copying a series of photographic images from a film strip on to a light sensitive film strip which includes: a plurality of convergent light beams of different wave lengths; an apertured guide frame disposed between the source of said beams and their point of convergence; an apertured control plate slidably carried by one face of said guide frame said plate having an aperture in each of said light paths; and a separate filter plate in the path of each light beam provided with a series of filters and slidably carried on the other face of said guide frame.

3. An apparatus for copying a series of photographic images from a film strip on to a light sensitive film strip which includes: a plurality of convergent light beams of different wave lengths; an apertured guide frame disposed between the source of said beams and their point of convergence; an apertured control plate slidably carried by one face of said guide frame; a separate filter plate in the path of each light beam provided with filters and slidably carried on the other face of said guide frame; a solenoid for causing movement of said first plate means adapted to be operated by movement of one of said films; and separate solenoids for causing movement of said separate filter plates and adapted to be energized by movement of said first plate means.

4. An apparatus as defined in claim 1 in which said first plate means is operated in response to notches in said film strip passing a given point.

5. An apparatus as defined in claim 1 in which said first plate means is operated by a solenoid which is energized as the result of a roller dropping into a notch on said film strip.

6. An apparatus as defined in claim 1 in which both of said plate means are released by solenoids and allowed to drop one position by gravity.

7. An apparatus as defined in claim 1 in which the movement of said first plate means causes the energization of a solenoid which releases said second plate means and allows it to move downwardly by gravity.

8. An apparatus as defined in claim 3 in which said control plate is provided with a latch-catch mechanism to limit its movement.

9. An apparatus as defined in claim 3 in which each of said filter plates is provided with a latch-catch mechanism to limit its movement.

10. An apparatus for copying a series of photographic images from a film strip on to a light sensitive film strip which includes: means for providing a plurality of converging light beams of different wave lengths; an apertured control plate slidably disposed between the source of said beams and their point of convergence; a separated filter plate disposed in the path of each of said beams; means responsive to movement of one of said films for causing movement of said control plate; and means operated by movement of said control plate for causing movement of one or more of said filter plates.

11. An apparatus as defined in claim 10 in which said control plate and said aperture plates are slidable vertically in frame means disposed between said light source and said point of light beam convergence.

12. An apparatus as defined in claim 10 in which the means for moving said control plate includes a solenoid.

13. An apparatus as defined in claim 10 in which the means for operating said filter plates includes a solenoid for each plate.

14. An apparatus for copying a series of photographic images from a film strip on to a light sensitive film strip which includes: means for providing a plurality of convergent light beams of different wave lengths; separate plate means in the path of each of said beams, each of said plate means being adapted to hold a plurality of filters; means for causing movement of said separate plate means independently to register successive apertures with their respective light beams; and control means actuated in response to movement of one of said films for actuating said filter plates singly or simultaneously as desired.

15. An apparatus as defined in claim 14 in which said control means includes a plate slidably mounted and a solenoid for causing the movement thereof.

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