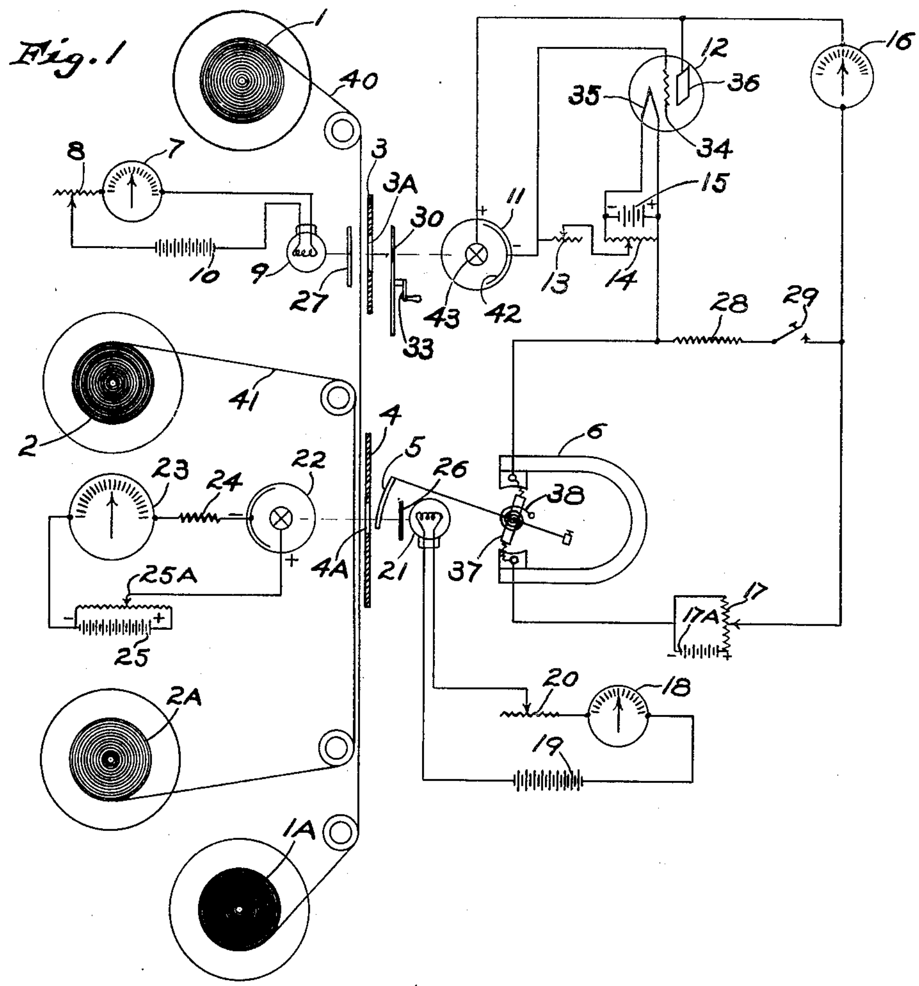
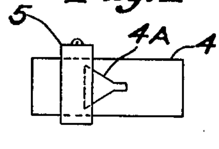
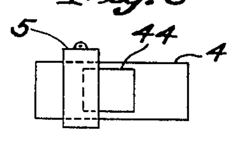
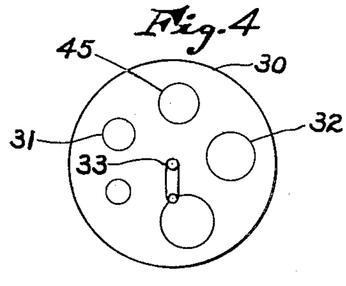
MOTION PICTURE FILM PRINTER

Filed June 9, 1930




Inventor
Delmar A. Whitson
by John Flam
Attorney

Patented Sept. 5, 1933

1,925,355

# UNITED STATES PATENT OFFICE

1,925,355

## MOTION PICTURE FILM PRINTER

Delmar A. Whitson, Los Angeles, Calif.

Application June 9, 1930. Serial No. 459,950

3 Claims. (Cl. 95—75)

In the preparation of positive motion picture films from negatives, it has been attempted to print the positive in such a way that the light values of the projected picture will correspond artistically and pictorially to the criterion required for effective reproduction. The negative, being taken under greatly varying light conditions, could not be so uniformly exposed as to render the printing of the positive merely a routine process. Instead, the varying density of the negative must be compensated for by printing some scenes more intensely than others.

This has been attempted to be accomplished, by making test strips of each individual scene. This strip is usually divided into a number of test pieces, each being printed for a different interval, and a skilled laboratory operator inspects the strip and notes the period of printing which he believes is best for that particular scene.

This procedure is not only time consuming and expensive, but in addition, it introduces a personal equation, rendering the results susceptible to error. Thus, error may result due to improper gauging of the intensities by the operator who inspects the test strip; or it may also result in incorrect application by the printer, of the data furnished him by the tester.

It is one of the objects of my invention to provide a printing mechanism of the character referred to, in which the personal element is obviated, thereby assuring against errors in printing that may arise from such a source.

It is another object of my invention to provide a printing system that is automatically and promptly adjusted to take care of any appreciable variations in the density of the negative, even if such a variation occurs from frame to frame, whereby a more accurate and more uniform positive film can be secured.

It is still another object of my invention to provide an automatic printer of the character referred to that is adjusted for printing intensities automatically in a substantially continuous manner, as distinguished from a system in which such intensities can be adjusted by comparatively large steps or increments.

My invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of one embodiment of my invention. For this purpose I have shown a form in the drawings accompanying and forming part of the present specification. I shall now proceed to describe this form in detail, which illustrates the general principles of my invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of my invention is best defined by the appended claims.

Referring to the drawing:

Figure 1 is a schematic wiring diagram of a printing system embodying my invention;

Fig. 2 is a detail of a shutter arrangement shown in Fig. 1;

Fig. 3 is a modified form of shutter that may be used with my system; and

Fig. 4 illustrates a test screen useful in adjusting the system.

I show a reel, from which the negative film 40 to be printed is fed in a uniform manner for the printing operation. The unexposed positive or raw film 41 is fed from a reel 2 and in contact with the negative film 40. Take-up reels 1A and 2A are respectively provided for the negative and positive films. It is of course understood that the printing operation takes place in a dark room. This operation consists in passing the two films 40 and 41 past an opening 4A in a baffle plate 4, through which is transmitted active rays, as from an incandescent lamp 21, the rays of which can if desired, be passed through an appropriate filter such as 26. It is apparent that as the film 40 and stock 41 are passed at a uniform rate past opening 4A, the stock 41 will be affected and it can then be chemically treated in well-known ways to secure a print for projection purposes.

In order to vary or control the intensity of printing, the effective opening through aperture 4A is varied, as by a valve member 5, movable across this aperture. This movement is automatic and responds to the testing of translucency of the negative 40, in a manner to be forthwith described. The intensity of illumination of lamp 21 must, of course, be kept constant, and this can be accomplished by adjusting its energizing current. Thus a battery 19, or other source of non-fluctuating electrical energy, can be used to energize lamp 21, through an adjustable resistance 20. A galvanometer or ammeter 18 can be provided to guide the operator for this adjustment.

The negative film 40 is tested for translucency at a station adjacent the aperture 4A, and thus the setting of valve 5 is made substantially simultaneously with the testing of that portion of the negative which is being printed, there being not more than a few frames intervening between the testing and printing stations.

In the present instance, actinic rays of fixed intensity are passed through the negative 40 as it passes an aperture 3A in a baffle 3, and the intensity of the rays after they pass through this aperture are caused to affect a light sensitive system, which in turn affects the position of valve 5 at the printing station. The testing light is provided from a lamp 9, the rays of which can if desired be passed through a color filter 27. This lamp is energized at an adjustable but constant value, as from a battery 10, and through a variable resistance 8. An ammeter or galvanometer 7 can be used to guide the adjustment of the energizing current to a desired constant value.

The testing of the negative translucency is accomplished in the present instance by the aid of a photo-electric cell 11. As is well-known, the impedance of such a cell varies in correspondence with the intensity of radiations imposed upon a cathode 42 therein, causing a variation in the space current between this cathode and a grid shaped anode 43. This cell is so located that the radiations transmitted through negative 40 and aperture 3A fall upon the cathode.

Since the usual photoelectric cell is incapable of passing more than a minute current, I provide means for amplifying these current variations so as to make them useful for affecting the position of valve 5. In the present instance, for accomplishing this result, I provide a conventional three electrode electronic emission amplifier 12. This amplifier is in the form of an evacuated vessel, and has a cathode 35 in the form of a heated filament for emitting electrons. These electrons are arranged to be received at an anode or plate 36, kept at a potential positive with respect to the cathode 35, as by an external circuit later to be described. The flow of electrons, forming a space current between cathode 35 and anode 36 is controlled by a control electrode or grid 34, interposed between the cathode and anode.

It is well understood that a comparatively small change in potential difference between the control electrode 34 and either of the other two causes a much larger change in the space current, thereby providing an amplifying effect that can be utilized in an output circuit connecting the anode 36 and cathode 35. The heating current for the cathode 35 is secured from a battery 15. The grid 34 and anode 36 are connected to the cathode 42 and anode 43 respectively of the photoelectric cell 12. In order to adjust the relative potential of the grid 34 with respect to cathode 35, a potentiometer resistance 14 is connected across battery 15, and a tap 14 leads to a variable resistance 13 in the cathode-grid circuit. By proper adjustment of the tap 14 and resistance 13, the tube 12 can be arranged to amplify faithfully the space current variations.

Of course as many stages of amplification can be used as desired, in order to provide the desired controlling current in the output circuit; but only one stage is shown for the sake of clearness. The output circuit can now be traced as follows: from a potentiometer resistance 17 that bridges the source of anode potential 17A, an ammeter 16, anode 36, cathode 35, a motor device 6, and back to potentiometer arrangement 17.

The motor device can be in the form of a galvanometer mechanism having a stationary field magnet and a movable coil 37 mechanically connected to valve 5. A torsion spring 38 serves to urge the valve 5 to extreme open position, while the torque, due to current in coil 37, exerts a force tending to close the valve 5. It is apparent from the foregoing that the greater the amount of light transmitted to cell 11 through the negative 40, the less the opening is through which the printing light from lamp 21 can pass. In order to ensure that the exposure will be correct and in accordance with the so-called logarithmic law; the valve 5 can be so arranged that the area of the printing opening defined by it is not merely a linear function of the current in coil 37, but can be arranged to be a logarithmic function. This is indicated in Fig. 2 by making the sides of aperture 4A non-parallel and converging. Alternatively, if other means be introduced to secure a non-linear response then the printing opening can be in the form of a rectangle, as indicated at 44 in Fig. 3.

Since accurate settings throughout the whole range of operation of valve 5 are essential for best results I provide means for calibrating, adjusting, and proving the system in various ways. For example, I provide a photosensitive device 22 in circuit with a galvanometer or microammeter 23 and grid leak resistance 24, to be effected by the light passing through lamp 21 and negative 40. A potentiometer 25A and a source of energy 25 serve to impress a definite set potential across the electrodes of cell 22.

In setting up the system for operation, lamp 21 is brought up to its rated current consumption by the aid of resistance 20. Shutter or valve 5 is entirely open, and neither film 40 or 41 impedes the free passage of light onto cell 22. Then potentiometer 25A is manipulated to bring microammeter 23 up to an indication on its scale to the maximum desired light exposure. After this adjustment is completed, the valve 5 is closed completely, as by closing a key 29 in the circuit of device 6, said circuit including a resistance 28 of proper value. The indication of microammeter 23 should return to a minimum or low reading of its scale. If it does not, then another trial must be made, by varying resistance 20 and potentiometer setting 25, until the correct high and low points on microammeter 23 are obtained when shutter or valve 5 is respectively opened and closed.

After this adjustment is thus accomplished, the scanning lamp 9 is energized to its rated wattage by adjusting resistance 8, and observing ammeter 7. The light from lamp 9 is passed through the color filter 27, as well as the exploring light port 3A, thence through a light gauge 30, and onto cell 11. As shown most clearly in Fig. 4, the light gauge is an opaque member that can be adjusted as on pivot 33 so as to bring any one of a number of graduated gauge openings 31, 32, 45 opposite the opening 3A. These openings 31, 32, 45 and any further openings in the gauge 30 have areas or translucencies corresponding to definite degrees of energization of device 6, the extreme openings 31 and 32 corresponding to minimum and maximum amounts of light for completely opening and closing valve 5.

When gauge 30 is set for any opening the microammeter 23 is observed for its reading in light units and note is made whether it reads correctly, not only for the extreme values, but also the intermediate values as predetermined by the areas of the intermediate gauge openings such as 45. Adjustment may be necessary of the resistance 8, resistance 13, and potentiometers 14 and 17 until the readings of microammeter 23 are consistent with the values assigned to the light gauge openings 31, 32, 45.

After this consistency is established the light gauge 30 can be rendered inactive, and the testing and printing started by threading films 40, 41 back of the various stations. Films 40, 41 can be fed off their reels 1 and 2 by any desired form of constant speed mechanism. Once started, the system can perform automatically, the valve 5 acting substantially simultaneously to pass the proper amount of actinic rays on the positive film 41 as it is moved past opening 4A.

I claim:

1. In a film printing system, means forming a printing aperture past which the film to be printed can be moved, a source of light for passing radiations through said aperture, a valve member controlling the effective area of the aperture, a check device for measuring printing intensities, said device including a photosensitive cell as well as an indicator of the degree of response of said cell, said cell being arranged to be subjected to the printing light through the aperture, means for controlling the position of the valve member in accordance with the translucence of the film from which prints are to be made; said controlling means including a source of radiations as well as defining an aperture opposite said source, and a photosensitive device affected by said source, and providing an energizing current for moving the valve member; and a light gauge movable between the photosensitive device and the said source of radiations, for facilitating adjustment of the system.

2. In a film printing system, a station for testing the translucence of the film from which prints are to be made, said station including a source of radiations, for passing through the film; as well as means for adjusting the intensity of the radiations, means forming a printing aperture past which the film can be moved; a valve member controlling the effective area of the aperture; means for controlling the position of the valve member in accordance with the translucence of the film as determined at the testing station; a check device, at the testing station, said device including a series of standard translucencies to be used in lieu of the film during the process of checking; and another check device at the printing aperture, said other check device including a light sensitive element capable of being subjected to the printing intensities in lieu of the film, and an indicator for the degree of response of said element.

3. In a film printing system, a station for testing the translucence of the film from which prints are to be made, said station including a source of radiations for passing through the film; as well as means for adjusting the intensity of the radiations, means forming a printing aperture past which the film can be moved; a valve member controlling the effective area of the aperture; means for controlling the position of the valve member in accordance with the translucence of the film as determined at the testing station; a check device, at the testing station, said device including a series of standard translucencies to be used in lieu of the film during the process of checking; and another check device at the printing aperture, said other check device including a light sensitive element capable of being subjected to the printing intensities in lieu of the film, an indicator for the degree of response of said element, and means for adjusting the indications to agree with the range of printing intensities; said two checking devices being arranged to be used concurrently prior to the printing and testing operation for adjusting the system.

DELMAR A. WHITSON.