April 20, 1937. C. L. LOOTENS 2,077,486

MOTION PICTURE FILM PRINTER

Original Filed Nov. 4, 1932 3 Sheets-Sheet 1

Fig 1

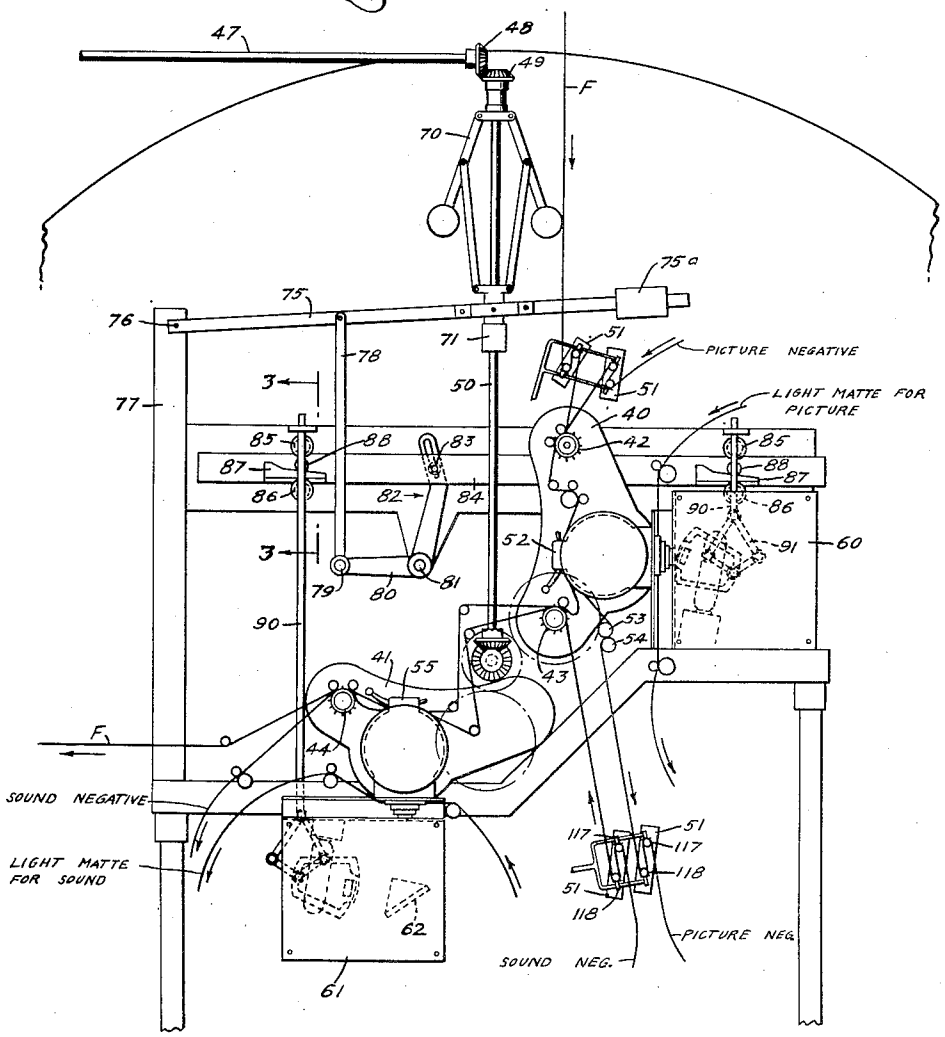
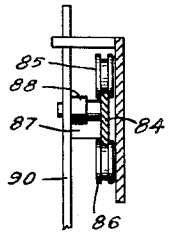


Fig 3



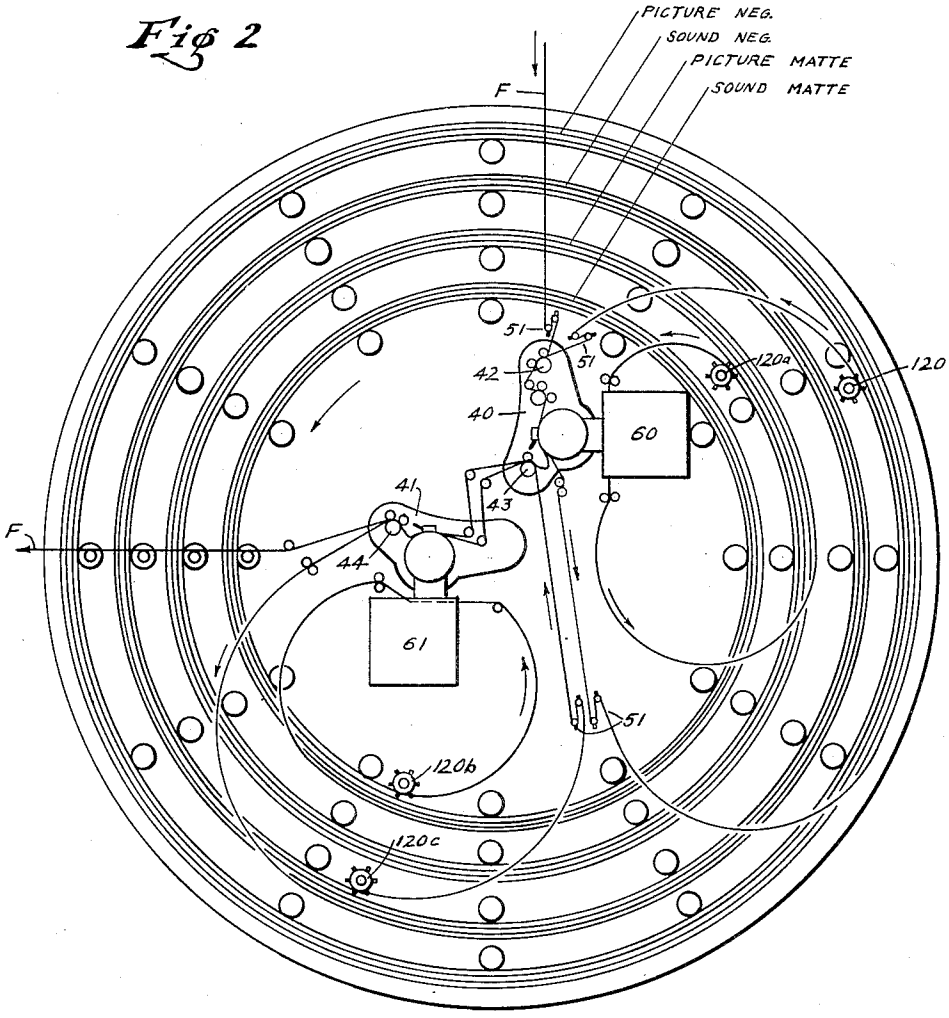
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MOTION PICTURE FILM PRINTER

Original Filed Nov. 4, 1932 3 Sheets-Sheet 2

Fig 2



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MOTION PICTURE FILM PRINTER

Original Filed Nov. 4, 1932 3 Sheets-Sheet 3

Fig. 4

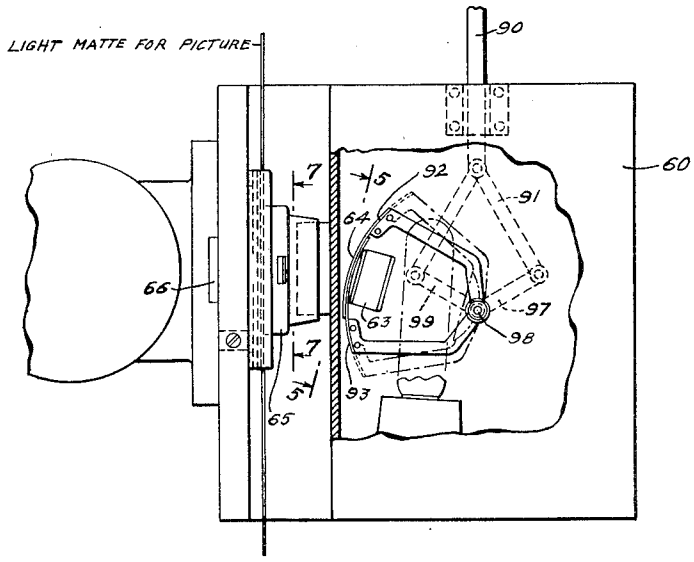


Fig. 5

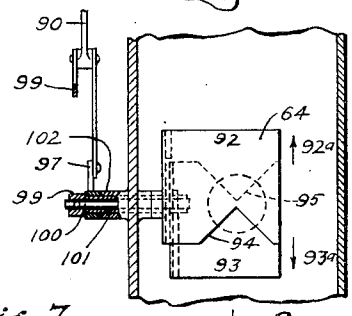


Fig. 6

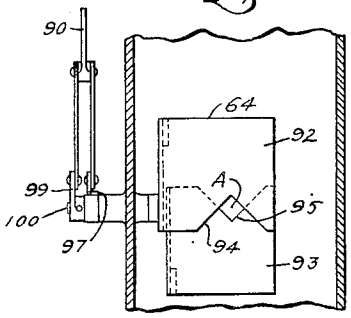


Fig. 7

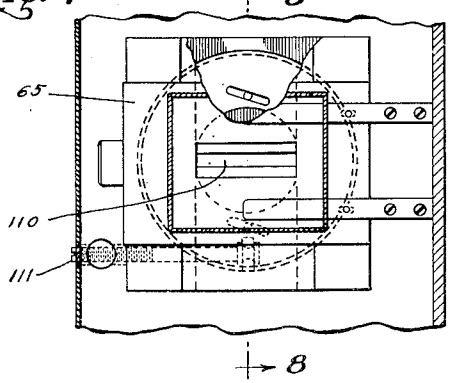
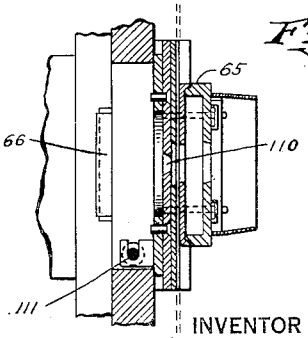


Fig. 8



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UNITED STATES PATENT OFFICE

2,077,486

MOTION PICTURE FILM PRINTER

Charles L. Lootens, Leonia, N. J., assignor to Cinema Patents Company, Inc., New York, N. Y., a corporation of New York

Original application November 4, 1932, Serial No. 641,247. Divided and this application October 26, 1934, Serial No. 750,167

5 Claims. (Cl. 95—75)

My invention relates to a motion picture film printer, this application being a division of my application for a Continuous film processing method and apparatus filed November 4, 1932, Serial No. 641,247.

My printer finds great utility as an element in a continuous film processing system wherein, as described in my aforesaid co-pending application, unexposed positive film is introduced at the ingoing end of a system and is printed, developed, dried and projected for inspection, by a continuous operation without intermediate rewinding or handling of the film. When my printer is used in such a system, it must be capable of operating at different speeds, so that if the printer has been stopped for inspection of film, or to put on a different negative, or for any other reason, it will function upon re-starting to deliver film at a rate faster than film is travelling through the developing machine in order to accumulate sufficient film in an elevator to provide for the next stoppage of the printer. The different printing light values, which have been predetermined and which are employed in printing different scenes or successive fractions of the film strip, are relative, and presuppose a uniform period of exposure before the printing gate or aperture. Since my printer is capable of being operated at different speeds, when the printer runs slow, the exposure is longer and when the printer runs fast, the exposure is shorter, so that unless control is provided for the basic light source the changing light scale will be ineffective.

It is, therefore, an object of my invention to provide a printer capable of operating at different speeds with consequently varying exposure periods, and automatic means for controlling the basic light source so that when the exposure period is increased the amount of light which reaches the printing aperture is decreased, and when the exposure period is decreased the amount of light is increased, the net result being a uniform exposure condition irrespective of the time of exposure.

To fully utilize the benefits of this present invention, I prefer to employ in conjunction with it an automatic rewind for the picture negative and sound negative as well as light mattes hereinafter described, so that the printer will be wholly automatic and continuous in operation; that is, so it will print any desired number of copies from a specific negative without the necessity of stopping the printer.

In the present types of printer used for exposing the positive film, it is customary to manually control the printing lights in order to obtain a print of approximately even density. These light changes are usually obtained by varying the diameter of an iris or the voltage of the lamp current. Such changes are not instantaneous and are susceptible to error due to the operator failing to make the necessary manual adjustment of the operating parts.

It is, therefore, another object of my invention to provide a printer in which the light changes are effected by means wholly automatic and not requiring the intervention of an operator after the negative film and the light control elements are once properly threaded in the machine.

In the drawings,

Figure 1 is a front elevation of the printer.

Figure 2 is an elevation, looking in the same direction as Figure 1, showing fragments of the printer and showing the continuous negative and light matte magazine to illustrate the relation of the printer and the magazine.

Figure 3 is a fragmentary cross-section taken on the line 3—3 of Figure 1.

Figure 4 is an enlarged detail of one of the light control gates shown in Figure 1.

Figure 5 is a fragmentary front view of a shutter element taken on the line 5—5 of Figure 4.

Figure 6 is a similar fragmentary view of the shutter element with the parts in different operative positions.

Figure 7 is a sectional view of another light aperture shield in the printer taken on the line 7—7 of Figure 4.

Figure 8 is a cross section of the same device taken on the line 8—8 of Figure 7.

Two printing elements 40 and 41 for picture and sound, respectively, are located in proximity on a suitable frame. Film passes continuously through the printing elements by means of driven film sprockets 42 43 and 44. These sprockets are rotated through shafts and gears, not shown, which derive their movement from a main power source such as an electric motor operating through a shaft 47, gears 48 and 49 and a vertical shaft 50. From the shaft 50, power is transmitted to sprockets 42, 43 and 44 by direct gear and shaft drive.

Picture negative, after travelling through a vacuum cleaner 51, comes in contact with the raw stock F at sprocket 42 and travels with the raw stock past the printing gate 52 of the printing element 40, coming out over rollers 53 and 54, then passing through another vacuum cleaner

before being wound up in the continuous negative magazine. Sound negative fed from the magazine, hereinafter described, comes in as indicated in Figure 1, contacting with the positive film at the sprocket 43 and passing with the positive film past the printing gate 55 of the printing element 41, thence over the sprocket 44 and out to the magazine. The positive film, travelling in the direction of the arrow on the left side of Figure 1, is delivered ready for development.

The light box for the printing element 40 is indicated at 60, and the light box for the printing element 41 is indicated at 61. The two are similar, except that printing light in the light box 61 is reflected by means of a prism 62. Only one of the light boxes will be described in detail.

Referring to Figure 4, light collected by condenser lens 63 passes through a control shutter 64, then through a gate 65, through diffusing glass 66 toward printing gate 52. The purpose of shutter 64 is the automatic control of the printing light which reaches the film, in a manner responsive to the speed of the printer. As previously explained, this is necessary because when the printer slows down, the film is before the printing gate a longer time, and therefore, requires less light; on the other hand, when the printer speeds up, the exposure is briefer, and therefore, the light must be greater. To accomplish this, the operating of the shutter (see Figures 5 and 6) is regulated by fly weights 70 (see Figure 1). It will be noted, that as shown in Figure 5, the shutter is closed, passing no light, while in Figure 6, the shutter is partly open, passing some light. This change is accomplished in the following manner:

When the shaft 50 is rotating, the fly weights swing outwardly under centrifugal force, thereby elevating a collar 71 which freely encloses shaft 50. When the parts were in the positions shown in Figure 1, with the printer idle, the shutter was completely closed as in Figure 5; but, when the printer is started, and collar 71 travels upwardly, it swings bar 75, which is pivoted at 76 on a frame member 77, and in swinging upwardly elevates a link 78. On the end of bar 75 is attached a weight 75a. The function of this weight is to load the fly weights so that they will be more stable in its response and operation. Also by adjusting the weight, the relation of speed and light transmission of the fly weight control system may be changed. Pivoted at 79 is a crank 80 which is pivotally mounted at 81; and a slotted end of the crank moves in the direction of the arrow 82. This movement is transmitted through a pin 83 to a horizontal bar 84 adapted to reciprocate between two pairs of rollers 85 and 86.

On this horizontal bar 84 are cams 87, the faces of which engage rollers 88, and in travelling in the direction of the arrow 82 raise the rollers.

Each roller 88 is pivoted to a vertical member 90 of a linkage 91, which is drawn upwardly by the movement of the horizontal bar 84 in the direction of the arrow 82. This upward movement of the linkage 91 causes the rotation in opposite directions of two accurate shields 92 and 93. Shield 92 rotates in the direction of the arrow 92a, and shield 93 rotates in the direction of the arrow 93a. The two shields have complementary V-shaped cut-away portions 94 and 95, the separation of which in more or less degree provides an aperture of greater or less area.

Shield 92 is rotated upwardly by means of a crank 96 pivoting at 98; and the shield 93 is rotated downwardly by a crank 97 having the same pivotal point 98. Thus it will be seen that as the speed of the shaft 50 varies, the position of the collar 71 changes and through the various elements just described the aperture at A is enlarged or diminished.

The pivotal point 98 mentioned is figurative. As will be noted in Figures 5 and 6, the crank 99 is locked to a pin 100, which is secured to the shield 93 and transmits the rotative force of the crank 99. Crank 97 is secured to a sleeve 101, which is secured to shield 92 and transmits to the shield 92 the rotative force of crank 97. The sleeve 101, which finds a bearing in a journal 102, in turn provides a bearing for the pin 100.

Due to lack of uniformity in the exposure of negatives, it is found in practice that different scenes in a single reel of negative will be of different densities; and as the release print should have an even density throughout, it is necessary to vary the volume or intensity of the light in the printer so that the release print, if developed under constant conditions, will have a uniform density and quality. The light change is effected in the old methods of film printing by having an operator manually re-adjust the printing light for printing each scene, sometimes as high as two hundred changes in a single reel.

In my printer, I provide an automatic light change, which, having once been set, will function without the intervention of an operator to change the light according to a predetermined schedule.

The light change element is in the form of a film matte having transparent center strips of different widths, depending upon the amount of light which it is desired to pass through. The matte is made by previously exposing a film behind different shields of the proper widths, then developing the film until the sides are opaque, while the unexposed center remains transparent. The method of preparing this light matte is the subject of another application for patent. There is one light matte for the picture negative and another light matte for the sound negative. Each matte is preferably in the form of a closed loop which, as shown in Figure 2, can be run through the printing device an indefinite number of times. In the interest of economy, I make the two light mattes relatively shorter than the picture negatives and sound negatives respectively, approximately in the ratio of one to four.

Referring to Figure 2, the course of the picture light matte through the printing element 40 may be readily traced. It is observed in greater detail in Figure 4, where it will be seen that the matte travels between the control shutter 64 and the film to be printed, passing adjacent to an aperture 110 shown in Figures 7 and 8. The horizontal dimension or length of the aperture is fixed and is the width of the film light matte. The vertical dimension or dimension parallel to the travel of the light matte is adjustable by means of the screw and cam mechanism 111 shown in Figure 7. The purpose of this adjustment is to provide a means of balancing the light of the picture printing aperture with the light of the sound track printing aperture. There is a similar adjustable aperture on the sound track printing head element. This adjustment may also be used to raise the general level of printing

light for both picture and sound printing elements.

In this connection I find it good practice to use a rheostat in series with the picture and sound printing lamps so that the voltage impressed on the lamp can be changed. I have found that this is an ideal means for controlling the overall light intensity, and I control the light intensity so that the developing time required is that to produce optimum results insofar as contrast is concerned. Also when the voltage on the printing lamps is decreased, the color temperature of the filament is decreased so that printing is accomplished with a more yellow light. In actual practice this seems to increase the contrast of printing thereby in part compensating for the contrast lost in a continuous printer. After the proper width adjustments have been made to aperture **110**, the printing light intensity is controlled by the various widths of light matte changes travelling through the gate **65**. The light matte widths are selected in advance, and are joined together in lengths proportionate to the negative scenes. A marker on the sprocket which pulls the light matte through the gate **65** serves as a synchronizing medium which is matched with a mark on the light matte. In this way the light change is made at the same time the scene changes.

A similar device is employed in conjunction with the sound printing element **41**.

As before noted, the picture negative is vacuum cleaned before and after the printing operation. The other films may be cleaned if it is found essential to do so.

In Figure 2, the continuous negative and light matte magazines are shown. Each one consists of a plurality of film supporting rollers arranged concentrically, the two light matte magazines being inside, due to their smaller capacity, and the picture and sound negative magazines, storing greater footage, being located outside. The two negatives and the two light mattes are each in the form of endless loops, so that they may be run through the printer repeatedly without stopping the apparatus to re-thread the film. The films are carried over the rollers of the respective magazines in a plurality of layers sufficient in number to store the films and properly confine them.

Arrows indicate the direction of travel of the four films, each being fed to the printing elements from inside the film layers by means of sprockets **120**, **120***a*, **120***b*, and **120***c*. After passing through the printing elements, the films are taken up on the outside layers.

The printer may be used without the continuous magazines. In that case suitable spindles are mounted on the frame structure for carrying ordinary film reels. The printer is threaded in the same way as heretofore described, the negatives and light mattes, after passing through the printing elements, being taken up on ordinary rewinders. At the end of each negative reel, it is necessary to stop the printer and re-thread it; but the negatives may be alternately run through backwards in order to eliminate an intermediate rewinding operation.

What I claim is:

1. A film printer comprising a printing light, a printing gate, means to pass a negative and a positive in printing relation past the printing gate, a light aperture the area of which is automatically enlarged or diminished according to the speed of said means interposed between the printing light and the printing gate, and means for changing the relationship between speed and area of light aperture.

2. In a motion picture film printer in which negative and positive film strips are caused to travel continuously before a printing light, the period of exposure of any given section of film being determined by the linear speed at which the films travel before the light, a diaphragm to regulate the amount of light which reaches the film, a control being coupled with the operating mechanism of the printer and responsive to the operating speed thereof and coupled also with the diaphragm to increase or decrease the amount of light reaching the films, said control including a device which can be adjusted to cause the control to respond to a given operating speed in a different degree.

3. A film printer comprising a printing light, a printing gate, means to pass a negative and a positive in printing relation past the printing gate, members forming a light aperture of variable area between the light and the gate, a regulating device cooperating between the said means and the said members to increase or decrease the area of the aperture inversely to change in speed of the said means, said regulating device including an adjusting element adapted to change the relationship between speed and area of light aperture.

4. A film printer comprising a printing light, a printing gate, means to pass a negative and a positive in printing relation past the printing gate, members forming a light aperture of variable area between the light and the gate, a regulating device cooperating between the said means and the said members to increase or decrease the area of the aperture inversely to change in speed of the said means, said regulating device including fly weights and a counterbalance opposing the fly weights, the counterbalance being adjustable to vary the effectiveness of the fly weights so that the relation between speed and area of light aperture may be changed.

5. A film printer comprising a printing light, a printing gate, means to pass a negative and a positive in printing relation past the printing gate, members forming a light aperture of variable area between the light and the gate, a regulating device cooperating between the said means and the said members to increase or decrease the area of the aperture inversely to change in speed of the said means, said regulating device including fly weights, a connecting link caused to shift by the fly weights and a counterweight upon the connecting link movable along said link to vary the effectiveness of the fly weights at any given speed.

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