

[54] **FILM PROCESSOR**

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250/209

[56] **References Cited**

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[57] **ABSTRACT**

In a film processor the replenishment pump is controlled by a single related to the accumulated measurement of light density of the developed film. Intermittently, in response to each one inch of travel of the film, a time delay circuit produces an electrical signal having a time duration related to the measured density of the film. Density measurements are accumulated in a servo motor rotated by the electric signal. For each revolution of the servo motor, a program selector energizes the replenishment pump for a time duration selected in accordance with the type of film being processed.

7 Claims, 4 Drawing Figures

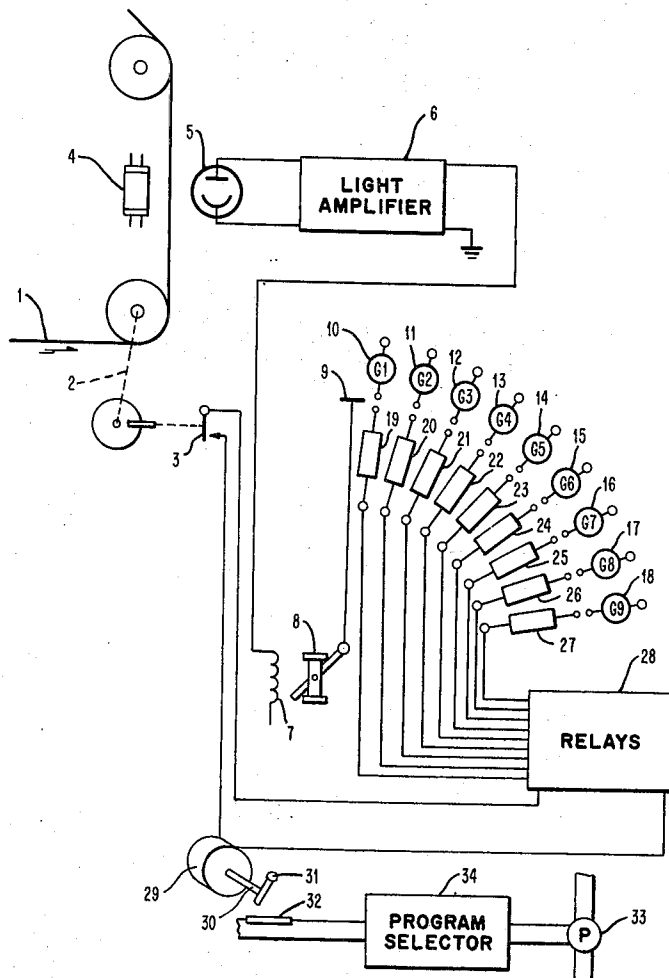
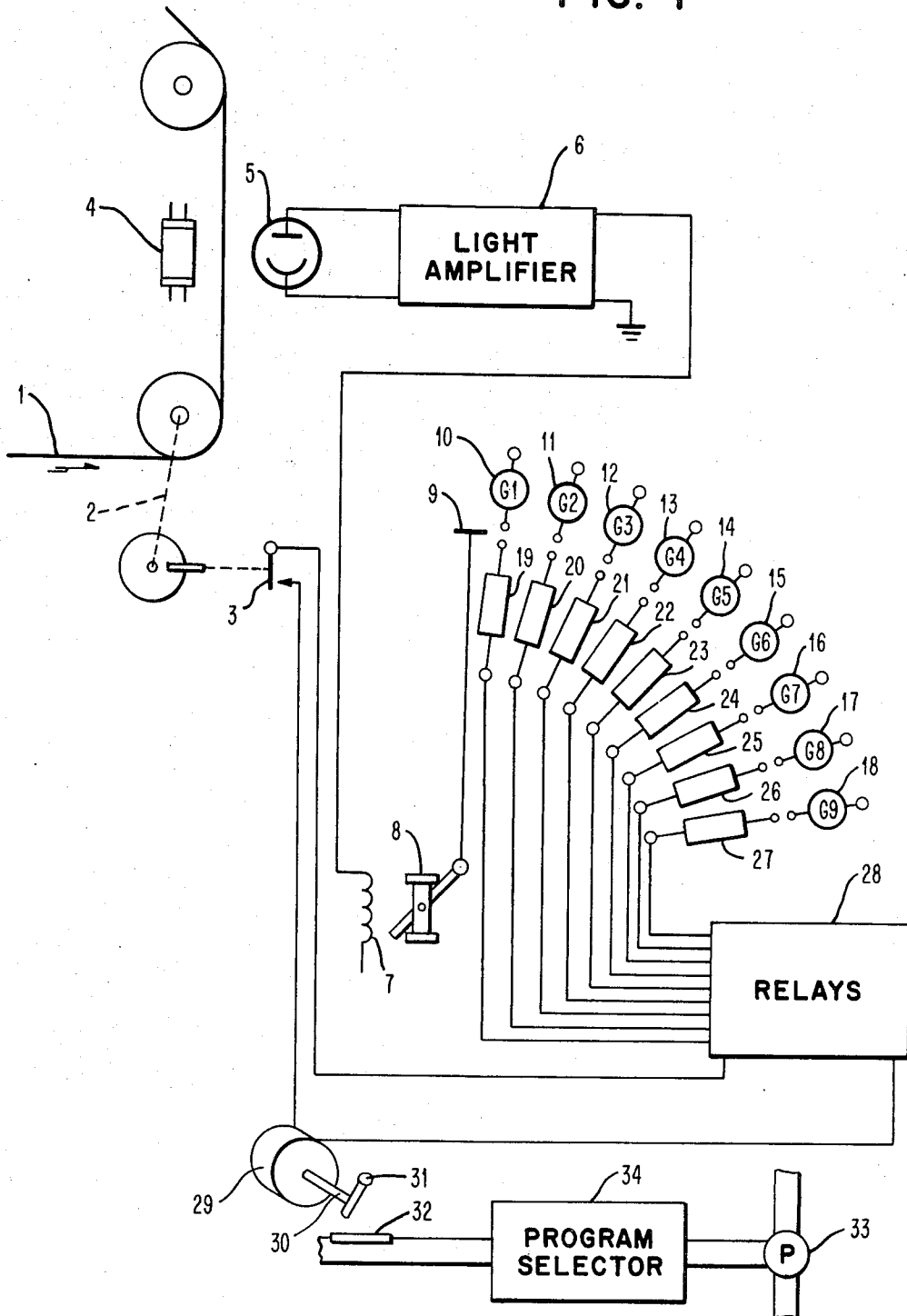


FIG. 1



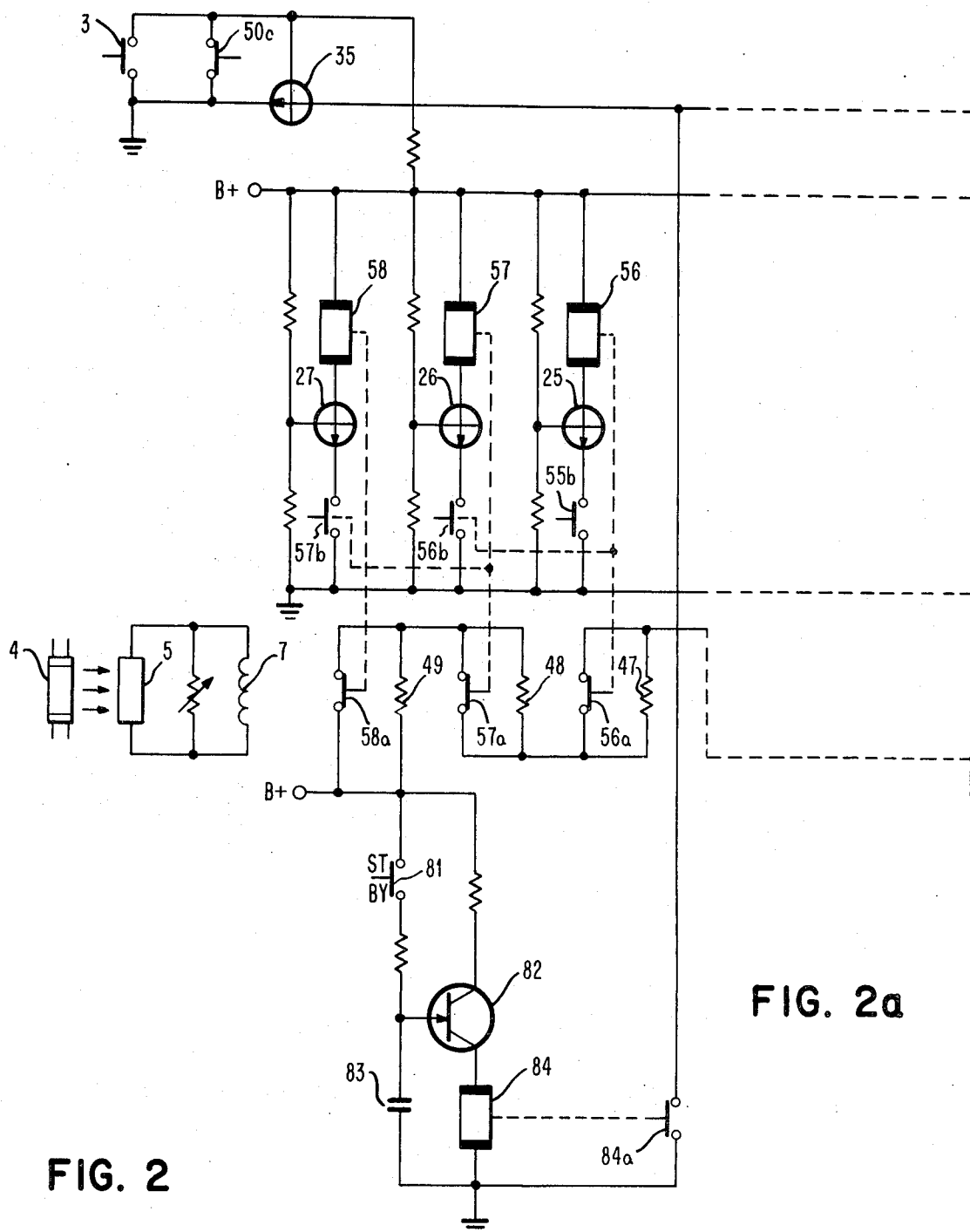
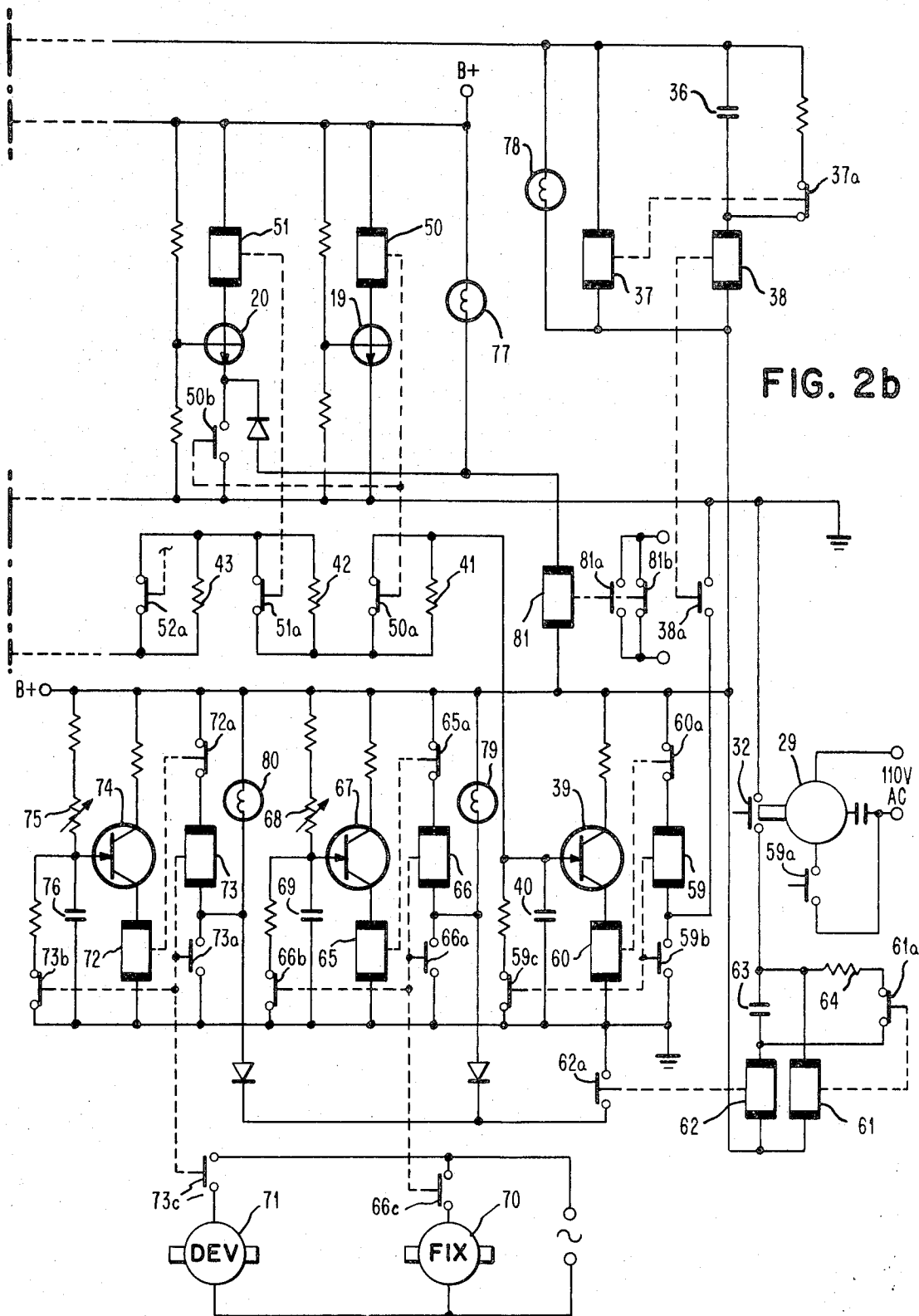


FIG. 2a

FIG. 2

FIG. 2a	FIG. 2b
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FILM PROCESSOR

BACKGROUND OF THE INVENTION

This invention relates to a light scanner unit for controlling the replenishment pump in a film processor. In order to obtain good quality photographic negatives, it is necessary to accurately control the concentration of the film developer and fixer. It has been recognized that the supply of developer material to the developer tank should be controlled in accordance with the light density of the exposed film. For example, U. S. Pat. No. 1,895,760 — Hunt controls the opening and closing of a valve supplying developer material to the tank. When the density of the film as sensed by a light sensitive device becomes lighter, the valve is opened. When the film darkens, the output of the light sensitive device closes the valve. In control systems such as this, the strength of the developer fluid will fluctuate widely. By the time that the light sensitive device detects enough increased darkness in the film to close the valve, too much fluid has probably already been added to the tank. Similarly, there is a finite time required between the sensing of a film lightness and the required addition of new developer material to the tank.

SUMMARY OF THE INVENTION

In accordance with an important aspect of the present invention, an accurately controlled amount of developer fluid is added to the developer tank in response to an electrical signal having a time duration related to the measured density of the film. A light sensitive device measures the light density of the developed film and electrical signals representing this density are accumulated. When the accumulation exceeds a given amount, the replenishment pump is energized to supply a given amount of developer material to the tank.

In accordance with another aspect of the present invention, the given amount of material which is added to the developer tank can be varied in accordance with a number of selectable programs selected in accordance with the type of film being developed.

In accordance with another aspect of the invention, electrical signals having time durations related to the measured density of the film are generated by a time delay circuit in which a meter movement, energized from the light sensitive device, interposes a flag between photo devices and associated lamps thereby actuating relays which selectively connect resistors in the time delay circuit.

In accordance with another aspect of the present invention, the electrical signals representing the measured density of the film are accumulated in a servo motor which actuates a switch, once for each revolution, thereby energizing the replenishment pump to supply the given amount of fluid to the developer tank.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the system; and

FIG. 2 shows the manner in which FIGS. 2a and 2b fit together to form the circuit diagram of the system.

DESCRIPTION OF A PARTICULAR EMBODIMENT

The system is represented by the block diagram of FIG. 1. In this Figure the film 1 is moved from the

development tank. A gear arrangement 2 actuates a microswitch 3 every one inch of movement of the film.

The light scanner includes the fluorescent tube 4 and photocell 5. The photocell 5 produces an output indicating the density of the developed film. This signal is amplified in light amplifier 6 and applied to the coil 7 of a galvanometer or meter. The meter movement 8 rotates in response to the applied current from the light amplifier.

The meter movement 8 moves a flag 9. As it moves, the flag is successively interposed between a glow (or glim) lamp and the associated photo resistor. The glow lamps 10-18 are shown in FIG. 1 together with photo resistors 19-27. As the meter movement rotates, successive ones of the photo resistors 19-27 are shielded from the incident light. When a photo resistor is shielded, an associated one of the relays in the bank of relays 28 is actuated. These relays switch resistors in a time delay circuit. For every inch of film travel, the closure of the microswitch 3 applies voltage to the servo motor 29. The time period that voltage is applied to servo motor 29 depends upon the number of relays actuated. For example, if the flag 9 shields only one photo resistor as it rotates, the voltage is applied to the servo motor 29 for only a short period of time. If two resistors are shielded, the voltage is applied for a longer period of time. If all nine of the photo resistors are shielded, voltage is applied to the servo motor 29 for a relatively long period of time.

The servo motor 29 rotates an amount dependent upon the time that voltage is applied to it. The servo motor acts as a counter or storage unit for storing an accumulation representing the density of the film during successive cycles of operation. The servo motor rotates the shaft so that the rotational position of the shaft represents accumulated density readings made by the photocell 5 during a number of closures of the microswitch 3. When the shaft 30 has made a complete revolution, the magnet 31 actuates the reed switch 32. The reed switch 32 operates the replenishment pump 33 to supply more developer to the developing tank. The time that the replenishment pump 33 is operated is adjusted by a program selector 34.

The program selector 34 provides the option of a number of different replenishment programs depending upon the type of film being used. Commonly, it may be set to provide the following ten programs:

5	Pgr. 1	gives at 1,200 cm ² fully exposed film	10 cc
	" 2	"	20 cc
	" 3	"	30 cc
	" 4	"	40 cc
	" 5	"	50 cc
55	10	" 6	60 cc
	" 7	"	70 cc
	" 8	"	80 cc
	" 9	"	90 cc
	" 10	"	100 cc

60 Program 5 is suitable for most types of film.

The circuitry is shown in more detail in FIGS. 2a and 2b. As previously indicated, the microswitch 3 is closed for each one inch of travel of the film. This acts, through DC amplifier 35, to trigger a one-shot circuit which includes capacitor 36 and relays 37 and 38. This one-shot circuit applies a constant time length starting impulse to the time delay circuit.

The time delay circuit includes the transistor 39, capacitor 40, and resistors 41, 42, 43 . . . 47, 48, 49. The resistors 41 - 49 are each shunted by a set of contacts 50a - 58a. These contacts are opened as successive ones of the relays 50 - 58 are energized. A number of these relays will be actuated depending upon the position of the flag carried by the meter movement. That is, the number of relays actuated will depend upon the density of the film as detected by the photocell 5.

Note that a set of contacts of each relay is connected in circuit with the photo resistor associated with the next succeeding relay. For example, the contacts 50b are connected in series with the photo resistor 20. This insures that the relays are energized and deenergized in succession as the flag moves to shield succeeding ones of the photo resistors.

When the time delay circuit, which includes the transistor 39, is first energized, the contacts 38a complete a circuit to energize the relay 59. The contacts 59a are closed thereby applying power to the servo motor 29. At the end of the time delay period the relay 60 is energized thereby opening the contacts 60a and deenergizing the relay 59. This opens the contact 59a thereby removing power from the servo motor. Therefore, the servo motor has rotated for a time period related to the density of the film.

This is repeated for each closure of the microswitch 3, that is, for each one inch of travel of the film. When the servo motor has accumulated density readings which complete one revolution of the servo motor, the reed switch 32 is picked up. This actuates a one-shot circuit which includes relays 61, 62, capacitor 63 and resistor 64. This one-shot circuit applies a starting impulse to two timing circuits. The first includes the relays 65 and 66, transistor 67, variable resistor 68 and charging capacitor 69. The variable resistor 68 is set to provide one of ten different time delays between 1 and 10 seconds. Therefore, the contacts 66c are closed to energize the fix pump 70 for a time duration between one and ten seconds. Since the pump delivers 10 cc. per second, the operation will be in accordance with one of the 10 programs previously listed.

The other time delay circuit controls the time that the developer pump 71 is energized. This time delay circuit includes relays 72 and 73, transistor 74, variable resistor 75 and charging capacitor 76. In a manner similar to that described for the other time delay circuit, variable resistor 75 can be varied to control the time period that the developer pump 71 is energized.

Several indicating lamps are shown in FIGS. 2a and 2b. The film lamp 77 is energized through the contacts 50b. As a part of the start-up procedure, the density meter is adjusted so the flag shields the photo resistor 19 thereby deenergizing the relay 50 so the lamp 77 goes out.

The relay 81 is also energized through the contacts 50b. The relay 81 actuates contacts 81a and 81b connected to terminals which can be used, for example, to start a magnet valve for supplying of fresh water for the water section in case the machine has a refrigerating plant built in. This will limit the water consumption.

The lamp 78 glows each time the microswitch 3 is closed, that is, for each one inch of travel of the film. This occurs only when the flag 9 shields a photo resistor. This indicates that the machine is operating.

When the flag is in the zero position, everything is turned off. The lamp 79 glows when the fix pump is energized. The lamp 80 glows when the developer pump is energized.

When the machine is not operating, that is, film is not running through the machine, provision is made to periodically energize the replenisher pumps, for example, every other hour, to keep the developer and fixing bath up to strength. To operate in this way, the standby button 81 is closed. This energizes a timing circuit including transistor 82, capacitor 83 and relay 84. The periodic closure of the contacts 84a acts in the same manner as closure of the microswitch 3 to accumulate density readings in the servo motor 29.

While a particular embodiment of the invention has been shown and described, it will, of course, be understood that various modifications may be made without departing from the principles of the invention. The appended claims are, therefore, intended to cover any such modifications within the true spirit and scope of the invention.

What is claimed is:

1. A film processor comprising:

a replenishment pump for supplying developer fluid to said film processor,
means for moving exposed film through said film processor,
a light sensitive device for measuring the light density of the developed film,
means for intermittently producing an electrical signal having a time duration substantially proportional to the measured density of said film,
means for energizing said replenishment pump at times determined by said electrical signal, and
a switch means actuated by the movement of film through said film processor, said switch means being connected to and operating said means for intermittently producing an electrical signal for each increment of film length which is processed.

2. The film processor recited in claim 1 further comprising:

program selector means for energizing said replenishment pump for differing time durations selectable in accordance with the type of film being processed.

3. The film processor recited in claim 1 further comprising:

means for accumulating the intermittent electrical signals having time duration proportional to the measured density of said film, the accumulated signals representing the accumulated density of film passing through said processor, said means for energizing said replenishment pump being actuated when the accumulated signal reaches a certain level.

4. The film processor recited in claim 3 wherein said means for accumulating comprises a servo motor, the intermittent electrical signals having time durations proportional to the measured density being applied to said servo motor so that the rotation thereof accumulates the measured density of said film, and

a reed switch actuated at the completion of each revolution of said servo motor, said reed switch being connected to said means for energizing said replenishment pump.

5. A film processor comprising:

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a replenishment pump for supplying developer fluid to said film processor,
means for moving exposed film through said film processor,
a light sensitive device for measuring the light density of the developed film,
means for intermittently producing an electrical signal having a time duration substantially proportional to the measured density of said film, said means for intermittently producing an electrical signal including
a time delay circuit including a charging capacitor and a plurality of resistors,
a plurality of relays for selectively connecting said resistors in said delay time circuit, and
means responsive to said light sensitive device for selectively energizing said relays, and
means for energizing said replenishment pump at times determined by said electrical signal.

6. The film processor recited in claim 1 wherein said means responsive to the output of said light sensitive device comprises:
a meter movement carrying a flag, the output of said light sensitive device being applied to move said meter movement,

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a plurality of photo devices respectively connected to said plurality of relays, and
a plurality of lamps, each positioned adjacent one of said photo devices, said flag being successively interposed between a lamp and the associated photo device as it moves, said photo devices being connected to and selectively actuating said relays.

7. A film processor comprising:
a replenishment pump for supplying developer fluid to said film processor,
means for moving exposed film through said film processor,
a light sensitive device for measuring the light density of the developed film,
means for intermittently producing an electrical signal having a time duration substantially proportional to the measured density of said film,
means for energizing said replenishment pump at times determined by said electrical signal, and
means responsive to the movement of film through said film processor, said means being connected to and operating said means for intermittently producing an electrical signal for each increment of film length which is processed.

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