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Wirtz et al.

[11] **3,812,372**

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[54] **SYSTEM FOR DETECTING A CHANGE IN LIGHT INTENSITY**

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[52] **U.S. Cl.** **250/561,** 250/206, 131/130

[51] **Int. Cl.** **G01n 21/32**

[58] **Field of Search** ..... 250/206, 214 R, 219 DQ, 250/219 DC, 207, 561, 559, 571; 131/130

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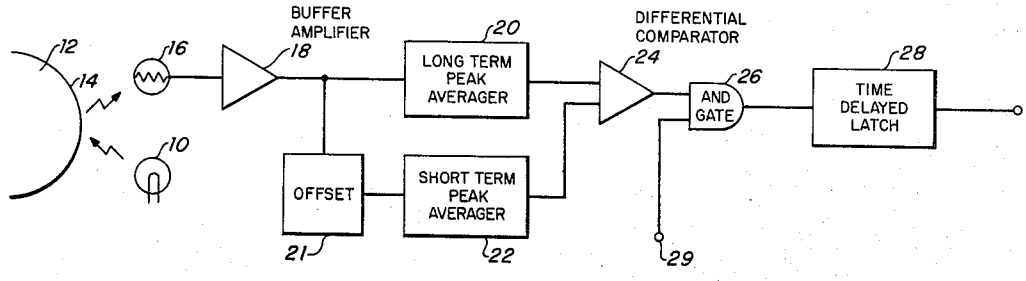
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[57] **ABSTRACT**

Apparatus for inactivating a direct lithographic press in response to the detection of a sheet of paper being undesirably stuck to the lithographic plate in the machine. The paper detection system includes a light source for illuminating the lithographic plate and a photodetector for detecting illumination reflected from the plate. The output of the photodetector is directed to two RC integrating circuits, one circuit having a relatively long RC time constant and the second circuit having a relatively short RC time constant. The integrating circuit with the long time constant follows slow changes in reflectance in the machine, and provides a self-adjusting reflectance reference. The slight contrast caused by the presence of the sheet of paper on the lithographic plate causes the output of the short time constant RC circuit to rise with respect to the output of the long time constant RC circuit. A comparator means coupled to the outputs of both RC circuits detects this increase, and produces an output signal which is directed to an AND gate. The AND gate has a second input for indicating that sheets of paper are being fed through the machine. When the AND gate receives both input signals, it produces an output signal which is directed to a time delayed latch circuit. When the AND gate produces an output signal for a period of time longer than the time delay of the latch circuit, the latch circuit produces an output signal to disable the machine.

12 Claims, 2 Drawing Figures



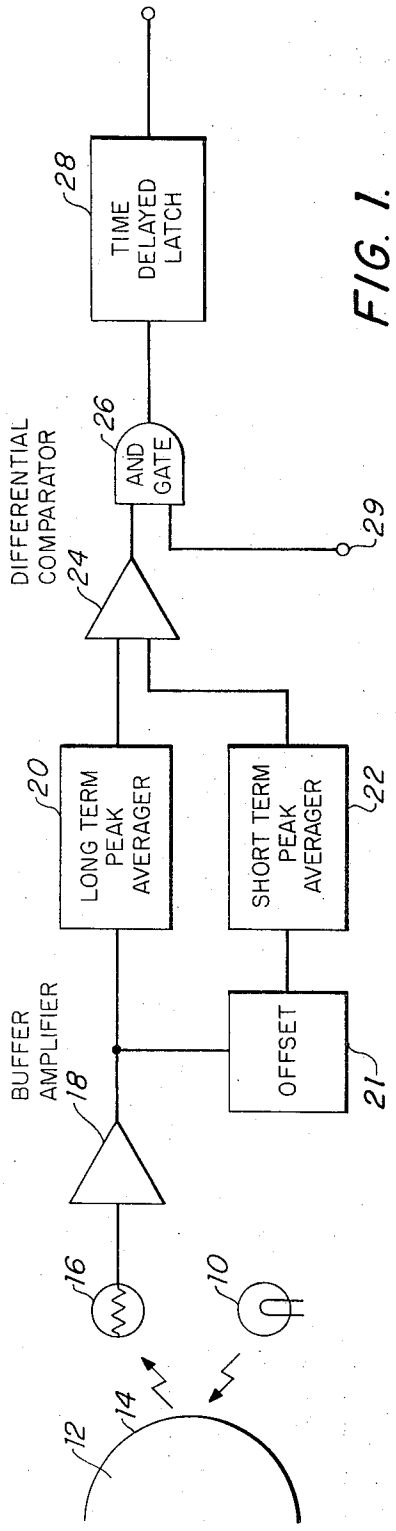

TIME DELAYED LATCH
28
AND GATE
26
DIFFERENTIAL COMPARATOR
24
29
LONG TERM PEAK AVERAGER
20
SHORT TERM PEAK AVERAGER
22
OFFSET
21
BUFFER AMPLIFIER
18
16
10
14
12

FIG. 1.

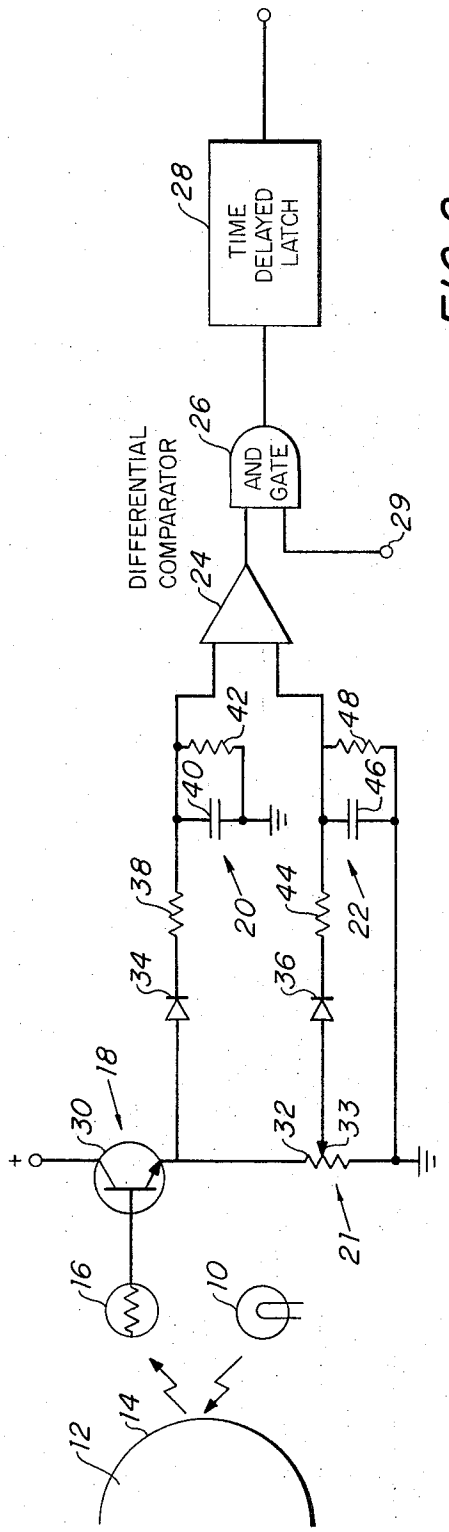

TIME DELAYED LATCH
28
AND GATE
26
DIFFERENTIAL COMPARATOR
24
29
42
40
48
46
38
44
34
36
20
22
18
30
32
33
21
16
10
14
12

FIG. 2.

SYSTEM FOR DETECTING A CHANGE IN LIGHT INTENSITY

BACKGROUND OF THE INVENTION

The present invention relates generally to reproducing equipment and more particularly pertains to a direct lithographic press machine wherein a system is included for detecting the undesired presence of a sheet of paper on the lithographic plate. In a direct lithographic press it is possible that a sheet of paper might stick to the plate and be carried into the ink and water meters. If this happens a good deal of damage may result. Conventionally this is prevented by detecting the presence of the paper sheet by its reflectance which is greater than the reflectance of the plate. However, when electrophotographic plate material is used, difficulties arise since the plate is characteristically pink, and there is very little contrast between the plate and the paper sheet. It is thus desirable to have a system which is capable of detecting the small contrast between the reflectance of the white paper sheet and the reflectance of the colored plate.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment, a system is disclosed for detecting a predetermined change in intensity of measured light. Further, the preferred embodiment provides such a system wherein a photodetector means detects incident light. The output of the photodetector is fed to long term averaging means and short term averaging means. The long term averaging means follows slow changes in intensity and provides a self-adjusting intensity reference. A comparator means compares the outputs of the long term averaging means and the short term averaging means and produces an output signal when the output of the short term averaging means rises with respect to the long term averaging means. Further, the preferred embodiment provides such a system wherein the photodetector detects the intensity of light reflected from an area. Also, the preferred embodiment provides such a system for utilization in a reproducing machine to detect the contrast caused by the presence of a paper sheet, and wherein the operation of the machine is altered in response to the detection of the paper sheet. Also the preferred embodiment provides such a system wherein the long and short term averaging means both utilize a peak averaging technique. Further, the preferred embodiment provides such a system for use in a direct lithographic press, and wherein the lithographic press is shut down in response to the detection of a paper sheet on the lithographic plate. Also the preferred embodiment provides such a system wherein the long term averaging means and the short term averaging means are RC integrator circuits having respectively a long RC time constant and a short RC time constant, and wherein the output of the comparator means is directed to an AND gate having as a further input a signal indicating that sheets of paper are being fed through the machine. Also, the preferred embodiment provides such a system wherein a time delayed latch circuit is coupled to the output of the AND gate to shut down the machine only after the AND gate has produced an output signal for a predetermined minimum period of time.

Although the preferred embodiment is illustrated as detecting intensity changes in reflected light, it should be realized that the teachings of this invention are applicable to detecting changes in the intensity of transmitted light or just ambient light.

One advantage of the preferred embodiment is that the long term averaging circuit provides a self-adjusting reference for the comparator circuit. The long term averaging circuit follows slow changes in the reproducing machine such as changes in the reflectance of the lithographic plate, changes in the illumination characteristics of the light source, drift effects in the detector, or power supply voltage fluctuations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a block diagram of a preferred embodiment of this invention.

FIG. **2** illustrates schematically some of the components shown in block form in FIG. **1.**

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. **1** illustrates a block diagram of a preferred embodiment of this invention. In the preferred embodiment, the system is utilized in a direct lithographic press. However, it should be realized that the invention has application in other types of reproducing machines and in general where a slight contrast is desired to be detected. Light from a source **10** illuminates the roller **12** in the direct lithographic press which, during operation of the press, carries a lithographic plate **14.** At the location where the roller **12** and plate **14** are illuminated, the sheet of paper just printed should have been discarded from direct contact with the plate during normal operation of the press. However, during a malfunction of the machine a paper sheet adheres to the plate at the location illuminated by the light source **10.** If the roller **12** continues to rotate, the paper sheet may be carried into the ink and water meters, thereby possibly resulting in a good deal of damage. Therefore, in the case of a malfunction where a sheet of paper is adhering to the plate **14,** it would be desirable to detect the presence of the paper and shut down the machine. When an electrophotographic plate is utilized, it is very difficult to detect the paper since the plate is characteristically pink and there is very little contrast between the pink plate and white paper.

The preferred embodiment of the invention uses a peak averaging technique which is able to respond to the small contrast between the white paper and the pink plate. Peak averaging is utilized as it allows the circuit to ignore reflections from nonrelevant darker areas of the roller, such as holes in the roller or grippers mounted on the roller. In alternative embodiments other averaging techniques may be utilized. In the preferred embodiment, the output of photodetector **16** is applied to buffer amplifier **18** which functions to isolate the detector **16** from the rest of the circuit. The output of buffer amplifier **18** is applied directly to a long term peak averaging circuit **20** and to a short term peak averaging circuit **22** through an offset circuit **21.** In the preferred embodiment it is desired to detect a rise in the short term averaged output with respect to the long term averaged output. The long term averaged output follows slow changes in the machine such as changes in the detector **16** from the rest of the circuit. The output of buffer amplifier **18** is applied directly to a long term peak averaging circuit **20** and to a short term peak averaging circuit **22** through an offset circuit **21.** In the

preferred embodiment it is desired to detect a rise in the short term averaged output with respect to the long term averaged output. The long term averaged output follows slow changes in the machine such as changes in the reflectance of the lithographic plate or changes in the illumination characteristics of the light source or drift effects in the detector. The long term averaging circuit therefore provides a self-adjusting reflectance reference for the comparator circuit **24.** Offset circuit **21** reduces the voltage applied to short term averaging circuit **22.** Differential comparator circuit **24** compares the outputs of the long and short term averaging circuits **20** and **22.** Because of the offset in voltage introduced by circuit **21,** differential comparator **24** detects a predetermined rise in the output voltage of the short term averaging circuit with respect to the voltage of the long term averaging circuit which occurs when the voltage difference between the outputs of circuits **20** and **22** is reduced to zero. When this voltage difference is reduced to zero the short term averaged signal has risen a predetermined amount with respect to the long term averaged signal because of the offset in voltage introduced by circuit **21.** At that point the output of differential comparator **24** changes to a positive state which indicates that a slight contrast exists on the surface of roller **12.**

The positive state of comparator **24** supplies one enabling signal to AND gate **26.** AND gate **26** has a second input, indicated at **29,** which also carries a positive voltage when sheets of paper are being fed through the reproducing machine. The system for indicating sheets of paper are being fed through the machine does not form a part of this invention, and accordingly that apparatus is not illustrated in detail. The possibility that a sheet of paper might undesirably stick to the lithographic plate exists only when sheets of paper are being fed through the lithographic press. Accordingly, AND gate **26** and the signal on line **29** function to ensure that a jam condition is not indicated at improper times. In addition it provides time for the long term averager to store a proper value. The output of AND gate **26** is directed to a time delayed latch circuit **28.** Time delayed latch circuit, like AND gate **26,** is a refinement on the basic invention and produces an output jam signal only after AND gate **26** has produced a signal for a predetermined minimum period of time determined by the time delay of latch circuit **28.** Time delayed latch circuit **28** ensures that transient responses do not jam the lithographic press. In the preferred embodiment, the output of latch circuit **28** is utilized to shut down the press so that the sheet of paper sticking to the lithographic plate does not get carried into the ink and water meters of the press, thereby possibly resulting in a good deal of damage.

Referring to FIG. **2,** there is illustrated a partially schematic diagram of the circuit shown in FIG. **1.** The output of photodetector **16** is directed to a buffer amplifier **18** which includes an NPN transistor **30** in an emitter follower circuit. The emitter of transistor **30** is coupled through a diode **34** to long term peak averaging circuit **20.** The voltage at the emitter of transistor **30** establishes a voltage drop across resistor **32** which forms the offset circuit **21.** Tap **33** takes part of the voltage across resistor **32,** and is coupled through a diode **36** to short term peak averaging circuit **22.**

Long term peak averaging circuit **20** is an integrating circuit consisting of a resistor **38** through which a capacitor **40** is charged. A second resistor **42** is shunted across capacitor **40** and functions as a bleed resistor. Likewise, short term peak averaging circuit **22** is an integrating circuit and has a capacitor **46** which is charged through a resistor **44.** Capacitor **46** is shunted by resistor **48** which functions to bleed capacitor **46.** In accordance with the peak averaging technique utilized in the preferred embodiment when the voltage at the emitter of transistor **30** exceeds the voltage across capacitor **40,** current flows through diode **34** to further charge capacitor **40.** Likewise when the voltage at tap **33** exceeds the voltage across capacitor **46,** current flows through diode **36** to further charge capacitor **46.** The RC time constants of long term averaging circuit **20** and short term averaging circuit **22** are determined by the values of each of the resistors and capacitors utilized in each circuit. The voltage at the output of short term peak averaging circuit **22** is normally less than the voltage produced by long term averaging circuit **20** because of the offset voltage introduced by resistor **32.** When a contrast exists on the surface of roller **12** and moves past photodetector **16,** it causes the voltage at the output of short term averaging circuit **22** to rise with respect to the voltage at the output of long term averaging circuit **20.** When the voltage from short term circuit **22** reaches the voltage of long term circuit **20,** differential comparator circuit **24** changes state and directs a positive output signal to AND gate **26.** The remainder of the circuit of FIG. **2** functions in the same manner as explained with respect to the circuit of FIG. **1.**

In one embodiment of this invention which was actually built, the press in which the preferred embodiment was implemented had roller **12** rotating at 120 rpm. The time constant of the long term averaging circuit **20** was selected to be 0.2 seconds, and the time constant of the short term averaging circuit **22** was selected to be 10^{-4} seconds. Time delayed latch **28** was designed to produce an output signal after a delay time of approximately 10^{-3} seconds.

During operation, jam detection was inhibited for four seconds after the circuit was activated to allow the long term averaging circuit **20** to reach equilibrium. During this four second time period no paper was fed through the machine, and accordingly an activating input was not present on line **29.**

While several embodiments have been described, the teachings of this invention will suggest many other embodiments to those skilled in the art.

I claim:

1. A system for detecting a predetermined change in intensity of measured light and comprising:

a. photodetector means for detecting incident light and for producing one output signal indicative of the intensity of said light;

b. long term averaging means coupled to the output of said photodetector means and responsive to said one output signal for producing a signal indicative of a relatively long term averaged output of said one output signal of said photodetector means;

c. short term averaging means coupled to the output of said photodetector means for producing a signal indicative of a relatively short term averaged output, as compared to said relatively long term averaged output, of said one output signal of said photodetector means; and

d. comparator means, coupled to the outputs of said long term averaging means and said short term averaging means, for detecting a predetermined change in the output of said short term averaging means with respect to the output of said long term averaging means and for producing an output signal upon the occurrence of said predetermined change, said output signal of said comparator means being indicative of said predetermined change in intensity of measured light.

2. A system as set forth in claim **1** and wherein said photodetector means detects the intensity of light reflected from an area.

3. A system for utilization in a reproducing machine to detect the slight contrast caused by the undesired presence of a sheet of paper over a background area and operating by detecting a predetermined change in intensity of light reflected from the background area and comprising:

a. photodetector means for detecting incident light and for producing an output signal indicative of the intensity of said light;

b. long term averaging means coupled to the output of said photodetector means for producing a signal indicative of a relatively long term averaged output of said photodetector means;

c. short term averaging means coupled to the output of said photodetector means for producing a signal indicative of a relatively short term averaged output, as compared to said relatively long term averaged output, of said photodetector means;

d. comparator means, coupled to the outputs of said long term averaging means and said short term averaging means, for detecting a predetermined change in the output of said short term averaging means with respect to the output of said long term averaging means and for producing an output signal upon the occurrence of said predetermined change, said output signal of said comparator means being indicative of said predetermined change in intensity of measured light; and

e. means, responsive to the output signal of said comparator means, for altering the operation of said reproducing machine.

4. A system as set forth in claim **3** and wherein:

a. said long term averaging means includes means for producing a signal indicative of the long term averaged peak output of said photodetector means; and

b. said short term averaging means includes means for producing a signal indicative of the short term averaged peak output of said photodetector means.

5. A system as set forth in claim **4** wherein:

a. said reproducing machine is a direct lithographic press reproducing machine; and

b. the system is utilized to shut down the machine.

6. A system as set forth in claim **5** wherein:

a. said long term averaging means includes an RC integrating circuit having a relatively long RC time constant; and

b. said short term averaging means includes an RC integrating circuit having a relatively short RC time constant as compared to the relatively long RC time constant of said long term integrating RC circuit.

7. A system as set forth in claim **6** and including:

a. an AND gate coupled to the output of said comparator means; and

b. means for directing a second input signal to said AND gate for indicating that sheets of paper are being fed through the reproducing machine.

8. A system as set forth in claim **7** and including a time delayed latch means coupled to the output of said AND gate for producing an output signal when said AND gate produces an output signal for a period of time longer than the time delay of said latch circuit.

9. A system as set forth in claim **3** wherein:

a. said reproducing machine is a direct lithographic press reproducing machine; and

b. the system is utilized to shut down the machine.

10. A system as set forth in claim **3** wherein:

a. said long term averaging means includes an RC integrating circuit having a relatively long RC time constant; and

b. said short term averaging means includes an RC integrating circuit having a relatively short RC time constant as compared to the relatively long RC time constant of said long term integrating RC circuit.

11. A system as set forth in claim **3** and including:

a. an AND gate coupled to the output of said comparator means; and

b. means for directing a second input signal to said AND gate for indicating that sheets of paper are being fed through the reproducing machine.

12. A system as set forth in claim **11** and including a time delayed latch means coupled to the output of said AND gate for producing an output signal when said AND gate produces an output signal for a period of time longer than the time delay of said latch circuit.

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