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Gregg

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[54] **SCANNING MECHANISM FOR FILM DEVELOPER, AND THE LIKE**

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[51] **Int. Cl.** **F21p 3/06,** G03d 3/10

[58] **Field of Search** ..... 95/89 R, 94 R; 240/8.12, 10.1, 61.13, 90, 7.55

[56] **References Cited**

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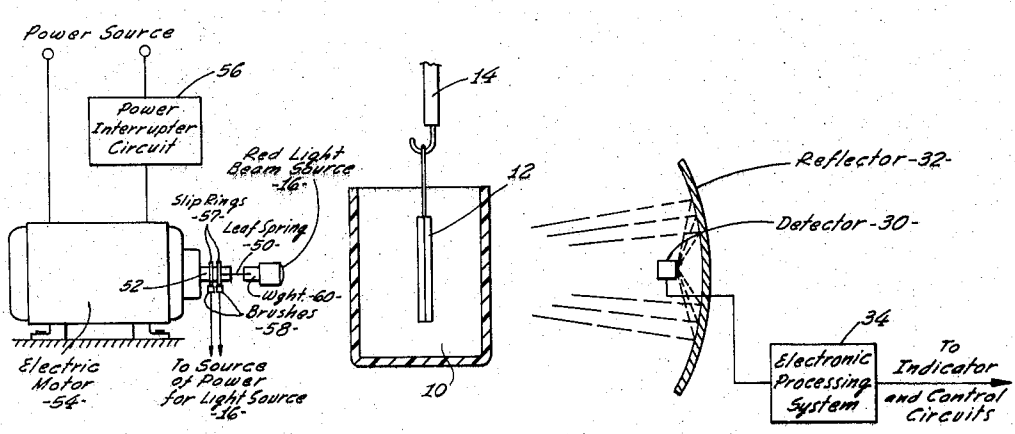
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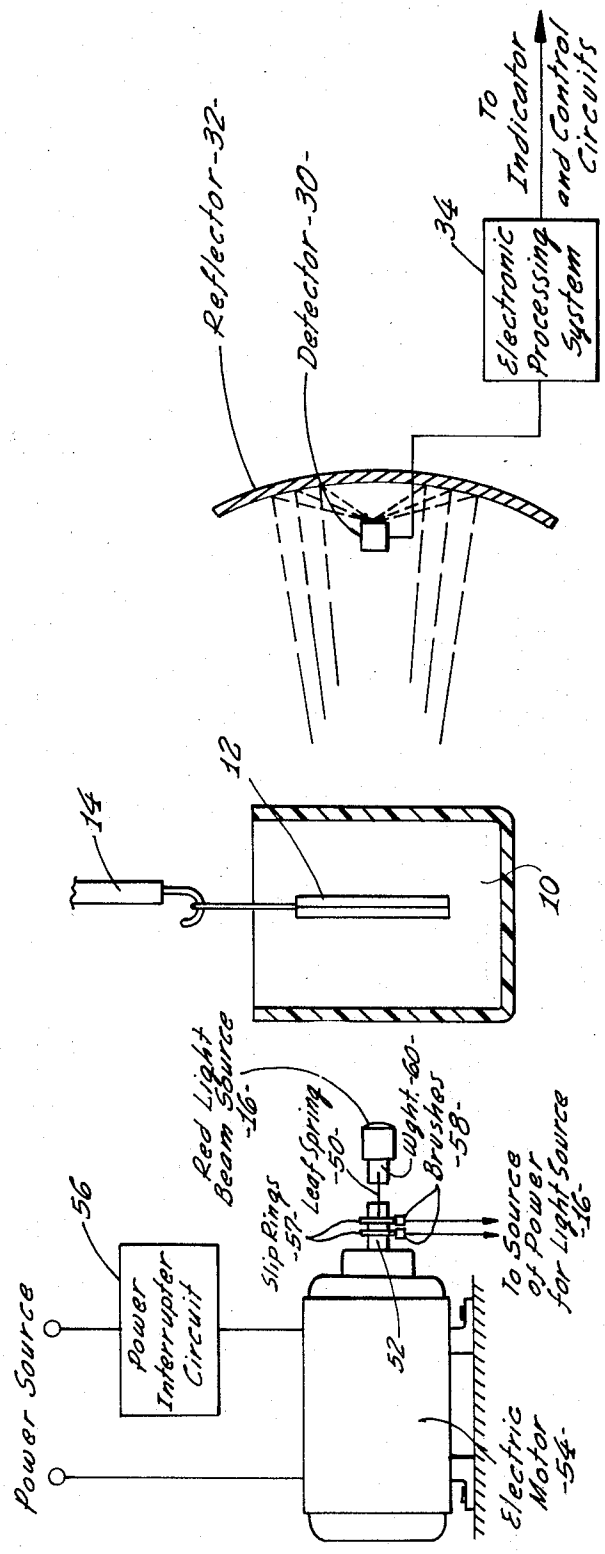
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[57] **ABSTRACT**

A light scanning mechanism for use in conjunction with automatic X-ray film developing apparatus, and the like. The mechanism permits a red beam to be repeatedly scanned across the film being developed in order to provide appropriate control signals so that the developing process may be stopped automatically when a desired density has been reached. The scanning mechanism includes a resilient member, such as a leaf spring, which couples the source of the red beam of light to a motor drive shaft. The motor is intermittently energized to cause the red beam to be cyclically moved in a random spiral scanning path.

4 Claims, 1 Drawing Figure




Reflector -32-
Detector -30-
34
Electronic Processing System
To Indicator and Control Circuits
12
14
10
Red Light Beam Source -16-
Leaf Spring -50-
Light -60-
Brushes -58-
Slip Rings -57-
To Source of Power for Light Source -16-
56
Power Interrupter Circuit
Power Source
52
Electric Motor -54-

SCANNING MECHANISM FOR FILM DEVELOPER, AND THE LIKE

BACKGROUND OF THE INVENTION

The scanning mechanism of the invention has particular utility in automatic film processing apparatus such as described in Copending application Ser. No. 214,924, filed Jan. 3, 1972, now abandoned. The apparatus described in the copending application is capable of causing film to be developed with a desired density and, within certain limitations, regardless of whether the film has been over-exposed or under-exposed, regardless of the temperature of the developing bath, and regardless of the depletion of the developing solution.

The apparatus of the copending application includes a control system which responds to the scanning of the exposed film in a developing solution by a red beam to cause the developing process to be terminated when a desired contrast is achieved. The red beam is derived, for example, from a laser, or other appropriate source of red light, and by subsequently transforming into electrical signals the radiant energy passing through the film and through the developer solution.

In the mechanism of the present invention, the desired scanning action of the red beam is derived, as will be described, by a simple resilient coupling between the source and a motor drive shaft.

As pointed out in the copending application, a major problem in developing photographic film is the establishment of a developing time which will permit a satisfactory density to be achieved, even though the film may have been over-exposed or under-exposed, even though the temperature of the developing solution may vary, or even when the depletion of the developing solution is unknown. This problem of achieving satisfactory density in X-ray films is especially prevalent in hospitals, clinics and dental offices, and it results in the technician or doctor's either having to interpret from less than satisfactory results, or having to perform expensive and time consuming re-takes.

The system and apparatus described in the copending application utilizes a red beam as a basis for controlling the time in which the exposed X-ray film is actually submerged in the developing solution. Since the X-ray film is relatively inesensitive to radiant energy in the red portion of the spectrum, there is little tendency for it to be fogged by the red beam.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is a cross-sectional schematic view, partly in block form, representing a developing system in which the scanning mechanism of the invention may be used, and showing an elevational view of one embodiment of the scanning mechanism.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

The apparatus illustrated in FIG. 1 includes a transparent bath or tank **10** in which an appropriate developing solution is contained. An exposed photographic or radiological film **12** is suspended in the solution in the bath **10** by a suitable film hanger **14.** The film hanger **14,** for example, may be part of an automatic film processing apparatus, whereby the film is carried from one bath to another during the developing process. A red radiant energy source **16** is provided, and this source may, for example, be a red light emitting diode, a helium-neon laser, or other known type of red light source. The red light source may be of continuous wave type or pulsed, for example, at a rate of 100 times a second by a suitable pulsing circuit to prevent excessive heating. The red light pulse width may, for example, be of the order of 200 microseconds, although any appropriate parameters may be used.

In the practice of the present invention, the source **16** is mounted on a resilient member such as a leaf spring **50** which, in turn, is mounted on the shaft **52** of an electric drive motor **54.** Slip rings **57** on the motor shaft, in combination with stationary brushes **58** conduct the necessary power from an appropriate electrical source of power to energize the laser. Flexible leads connect the slip rings to the input terminals of the red light source **16.** A small eccentric weight **60** is fastened to one side of the resilient housing of the laser. The drive motor **54** may, for example, be an induction type, and it is driven from an appropriate alternating current power source through a power interrupter circuit **56.** The power interrupter circuit periodically interrupts the power to the motor **54** so that it is intermittently energized.

It will be appreciated that each time the electric motor is energized, the resulting acceleration of the drive shaft **52** will cause the leaf spring **50** to bend increasingly under the effect of the unbalanced mass of the eccentric weight **60,** so that the red point source **16** is driven along a conically spiral path with respect to the axis of rotation of the motor shaft **52.** This causes the red beam from the red light source **16** to be scanned spirally across the film **12** within the transparent tank **10.** The spiral scanning occurs in a manner such that the area of the film **12** is sampled to a large degree. When the spiral scan has increased to a radius equal to the outermost portion of the film in the tank, the power to the motor **54** is interrupted and a braking force is applied, giving a rate of deceleration equal to that of the previous acceleration. Therefore, the compliance of the leaf spring **50,** in combination with the decreasing rotational speed of the weighted laser housing, **16** and **58,** causes the spinning red light source **16** to describe an ever smaller radius and hence a contracting conical spiral scan, which randomly samples once again the area of the film **12.**

The spiraling scanning red beam, after it has passed through the transparent tank **10,** through the solution in the tank **10** and through the film **12,** is reflected from a reflector and is detected by a red energy detector and electric transducer **30** at the focus. The scanning beam may be reflected to the detector from all its scanning positions by means, for example, of a prolate semi-ellipsoidal reflector **32.** The reflector **32** is positioned on the opposite side of the tank **10** from the scanning beam from the red source **16,** as shown. The reflector may be replaced, for example, by a convex lens, a Fresnel lens, a Zone plate, or other appropriate optical equipment. The red detector **30** may, for example, be a silicon photo diode, or any other appropriate red light sensor may be used.

The electrical output from the red energy detector **30** is applied to an electronic processing circuit designated **34,** which is described in detail in the aforesaid copending application. The output from the processing circuit **34,** may, for example, be used to activate any appropriate indicator or control circuit, as fully described in the copending application.

The invention provides, therefore, a simple and expeditious mechanical scanner which has a multiplicity of uses, and which finds particular use in an automatic film developing system. It will be appreciated that while a particular embodiment of the invention has been shown and described, modifications may be made. It is intended in the following claims to cover all modifications which come within the spirit and scope of the invention.

What is claimed is:

1. A scanning mechanism for a photographic film developing apparatus, or the like, comprising: a drive motor having a drive shaft; a bendable resilient member having one end mounted on said drive shaft; and weight means including a radiation source mounted on the other end of said resilient member in position to cause said resilient member to bend increasingly upon acceleration of said drive shaft and to bend decreasingly upon deceleration of said drive shaft, said radiation source being displaced radially of the axis of rotation of said drive shaft by increasing amounts as said drive shaft rotates at accelerated speeds and by decreasing amounts as said drive shaft rotates at decelerated speeds so that said source is driven along a conical path.

2. The scanning mechanism defined in claim 1, in which said resilient member is configured as a leaf spring.

3. The scanning mechanism defined in claim 1, in which said radiation source is a red light source.

4. A scanning mechanism as defined in claim 1, and which includes a power interrupter circuit connected to said motor for periodically interrupting the power to the motor for causing cyclic variations in the speed of the motor.

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