United States Patent [19]

Bauer

[11] **3,820,900**

[45] **June 28, 1974**

[54] **INSTRUMENT FOR SCANNING DOCUMENT FOR QUALITY**

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[22] Filed: **Dec. 15, 1972**

[21] Appl. No.: **315,734**

[52] **U.S. Cl.** **356/200**, 356/222, 250/571

[51] **Int. Cl.** **G01n 21/16**, G01n 21/32

[58] **Field of Search** ..... 250/200, 204, 106, 571, 250/219 Q; 356/200, 222, 102

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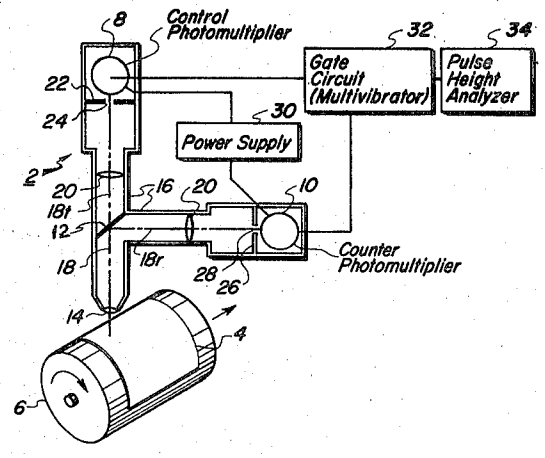
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Primary Examiner—Ronald L. Wibert

[57] **ABSTRACT**

An apparatus to scan, detect, and count speckle or background "noise" on a surface such as a xerographic copy. The object surface is scanned simultaneously through a pair of apertures, one larger than the other. A photocell associated with each aperture provides an electrical pulse, proportionate in height to its illumination. Sufficient light from the copy surface through the larger (control) aperture signals its photocell to keep open a gate circuit. Simultaneously, a signal received through the smaller (counter) aperture is counted as "noise." If the control aperture and its photocell receive light below a certain threshold level, (as when a print character is scanned) the gate circuit is closed and signals from the counter aperture are not counted.

1 Claim, 2 Drawing Figures



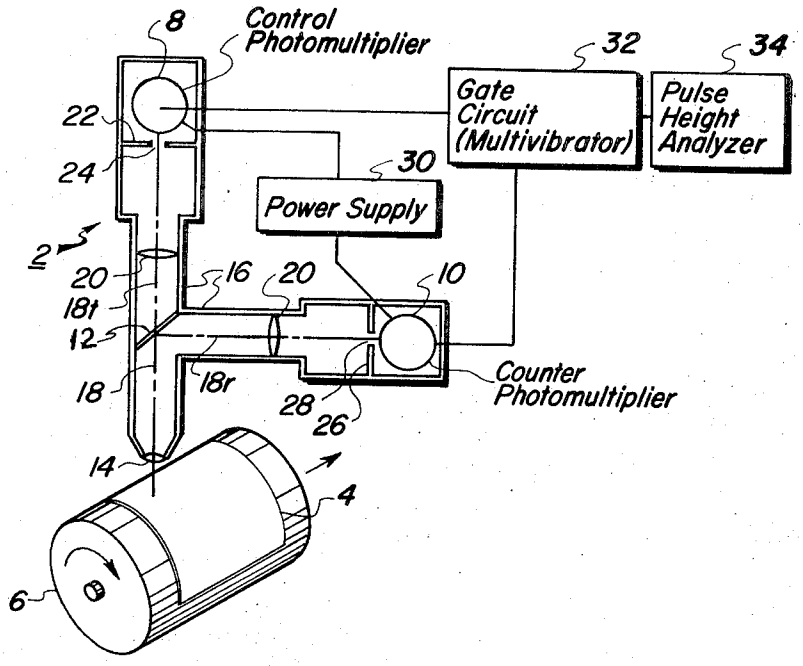

8
Control Photomultiplier
32
34
Gate Circuit (Multivibrator)
Pulse Height Analyzer
22
24
30
Power Supply
2
20
16
20
10
18t
12
18
18r
28
26
Counter Photomultiplier
14
4
6

FIG. 1

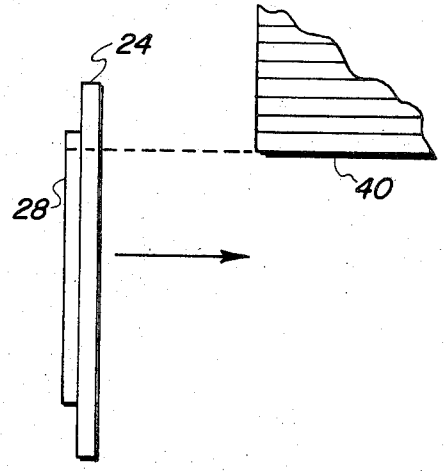

24
28
40

FIG. 2

INSTRUMENT FOR SCANNING DOCUMENT FOR QUALITY

BACKGROUND OF THE INVENTION

This invention relates to instruments for the detection and measurement of speckle or "noise" on specimen surfaces. More particularly, this invention relates to an instrument for the scanning of copy surface, such as the surface of xerographic copy, to determine the presence and level of low density background noise on the copy.

In the prior art, microphotometers are used to measure the granularity of photographic images. Fluctuations of transmitted (or reflected) light are measured while the image is scanned and from the results the granularity can be calculated. The scanning is typically not total but random sampling, and the method is statistical.

In xerography, a method more closely related to subjective observations is desirable for the measurement and interpretation of low density background noise. The presence of large toner particles on a document is material to the quality of images. To relate the number and size distribution of large particles to the image quality, it is necessary to scan a large area of the document or, preferably, the entire document. Present scanning microphotometers are relatively slow and more importantly they scan both printed text and background creating problems in the evaluation of the results.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an instrument capable of scanning a document for background noise while automatically overlooking desired print characters.

Further objects, advantages and features of this invention will become apparent from the following description of one embodiment, given in connection with the accompanying drawings.

The present invention is practiced in one form by a pair of scanning apertures exposed to a copy surface. The two apertures scan the same or adjacent areas of the scan image. One of the scanned areas (that is, one of the scanning apertures) is larger than the other. Sufficient light from the copy surface through the larger (control) aperture photoelectrically maintains an open gate circuit. Simultaneously a signal received through the samller (counter) aperture pulses a counting apparatus. When insufficient light enters the control aperture (as when a print character is scanned) the gate circuit is closed and signals from the counter aperture are not counted.

DRAWING

FIG. 1 is a somewhat schematic diagram of a scanning apparatus according to this invention.

FIG. 2 shows a side by side comparison of the two scanning apertures, indicated in operative relationship to a copy character.

DESCRIPTION

Referring now to FIG. 1, a scanning apparatus is indicated generally at 2 and is shown in operative position relative to an object surface or document 4 mounted on a suitable mechanism 6 for movement relative to the

scanning apparatus 2. As shown, mechanism 6 is a drum capable of rotation and axial translation to effect scanning motion. The details of mechanism 6 are not material to this invention, and any known mechanism to effect the desired relative motion between scanning apparatus 2 and object surface 4 may be used.

Scanning apparatus 2 includes an objective lens 14 disposed adjacent the object surface 4 on an optical axis 18. Behind the objective 14 is located a beam divider 12 from which the optical axis 18 is divided into two branches 18*t* and 18*r*. Outwardly of beam divider 12, branch 18t of optical path 18 includes, in optical alignment a, projection lens 20, a mask 22 defining a control aperture 24, and a control photomultiplier 8. Similarly, branch 18*r* of optical path 18 includes, in optical alignment, a projection lens 20, a mask 26 defining a counter aperture 28, and a counter photomultiplier 10. All of the elements from the objective 14 to the photomultipliers 8 and 10 are mounted on a suitable support structure 16. Lenses 14 and 20 image the scan surface at the apertures 24 and 28.

Apertures 24 and 28 may be optically superposed relative to the objective lens 14 by the beam divider 12 so that they simultaneously align with the same portion of the scan image (though aperture 24, being the larger, covers more). In other words, apertures 24 and 28 may be similarly located with respect to branches 18*t* and 18*r*, respectively of the optical axis 18.

Apertures 24 and 28 may also be offset or side-by-side relative to the objective lens 14 and branches 18*t* and 18*r*, so that they simultaneously align with adjacent portions of the scan image.

Photomultipliers 8 and 10 are connected to a suitable power supply 30. Control photomultiplier 8 is operatively connected to, and in control of, a multitivibrator gate circuit 32. Counter photomultiplier 10 is operatively connected, through the gate circuit 32, to a pulse height analyzer 34. A photoelectric signal above a threshold level from the control photomultiplier 8 maintains the gate circuit 32 open. When gate circuit 32 is open, a signal from the counter photomultiplier 10 is transmitted to pulse height analyzer 34.

Referring now to FIG. 2, the apertures 24 and 28 are represented schematically side-by-side and in association with a print character 40 on the object surface. Apertures 24 and 28 are shown here side-by-side, though as stated above they may also be superposed with respect to the objective lens 14. Control photomultiplier 8 is exposed to light through aperture 24 and if the light or optical signal received through aperture 24 is below a threshold level, photomultiplier 8 closes the gate circuit 32. Conversely, an optical signal above the threshold level operates through the photomultiplier 8 to keep the gate circuit 32 open.

In operation, consider the occurrence of a text or print character 40 on the object surface traversing the scanning objective lens 14 (and hence the apertures 24, 28), as represented by the dotted line. Projection of even a small area of character 40 onto the counter aperture 28 causes an optical signal to the counter photomultiplier 10. Without the gate circuit 32 this signal at 10 would transmit to pulse analyzer 34 and be counted. However, the character 40 is also projected through the control aperture 24 which, being offset and larger than aperture 28 senses a larger area of the character 40. The decrease in optical signal generated by this decreased illumination through the aperture 24 causes

the control photomultiplier **8** to close the gate circuit **32** so that the signal from the counter photomultiplier **10** is not transmitted to the pulse analyzer **34.** The desired print character **40** is thus not counted as background noise or speckle. By off-setting the light apertures and by having the larger aperture control the gate circuit **32** this apparatus acts as a go-not go gate to sort out and count only signals below a certain size.

The foregoing description of this invention is given by way of illustration and not of limitation. For example, the scanning apertures have been shown as rectangular but they may as well be square, circular or most any other convenient geometry. The concept and scope of the invention are limited only by the following claims and equivalents thereof which may occur to others skilled in the art.

What is claimed is:

1. A scanning apparatus to detect and count speckle on an object surface including:

an objective lens disposed on an optical axis relative to said object surface for scanning said object surface,

a beam divider disposed in said optical axis behind said objective lens to divide said optical axis into transmitted and reflected components,

a control aperture disposed along one of said components of said optical axis in conjugate relationship to said object surface,

a counter aperture, smaller than said control aperture, disposed along the other of said components of said optical axis in conjugate relationship to said object surface,

said control aperture and said counter aperture being partially optically superposed relative to said optical axis,

a control photosensitive element in optical communication with said control aperture, said control photosensitive element operatively connected to a gate circuit and maintaining said gate circuit open when exposed to light above a threshold level and closing said gate circuit when exposed to light below said threshold level so that said gate circuit is either open or closed,

a counter photosensitive element in optical communication with said counter aperture, said counter photosensitive element operatively connected, through said gate circuit, to a pulse counter whereby signals from said counter photosensitive element are counted when said gate circuit is open and said signals are not counted when said gate circuit is closed.

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