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(54) **MULTIPLE-FIELD SENSOR FOR SCANNING SYSTEM**

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(21) Appl. No.: **11/318,393**

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Related U.S. Patent Documents

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(52) **U.S. Cl.** **358/514**; 358/512; 358/408; 358/517; 250/208.1; 348/297

(58) **Field of Classification Search** 358/514, 358/512, 408, 517, 482; 250/208.1; 348/297, 348/298
See application file for complete search history.

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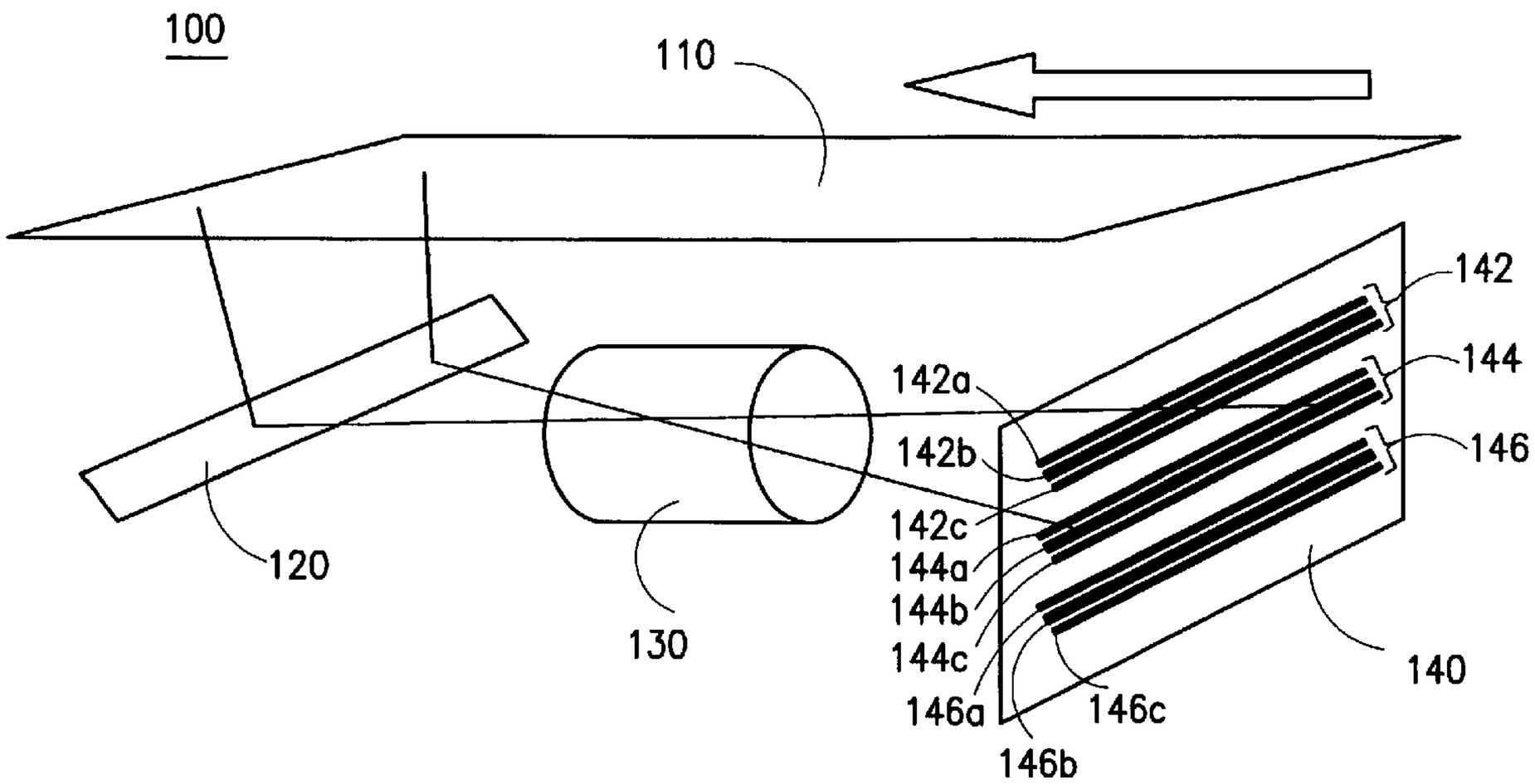
(57) **ABSTRACT**

A multiple-field sensor for a scanner suitable for scanning a document. The scanner includes a multiple-field sensor, an average accumulator, and a block of memory. The multiple-field sensor has a plurality of sensing lines for each color channel. Each sensing line picks up a portion of image signal from the document during scanning. The sensing lines scan the same portion of the document to produce corresponding image signals. The average accumulator averages the image signals obtained from the sensing lines of the same color channel to produce an average image signal. The block of memory is used as a storage area for image signals in general and the average image signal in particular.

26 Claims, 3 Drawing Sheets



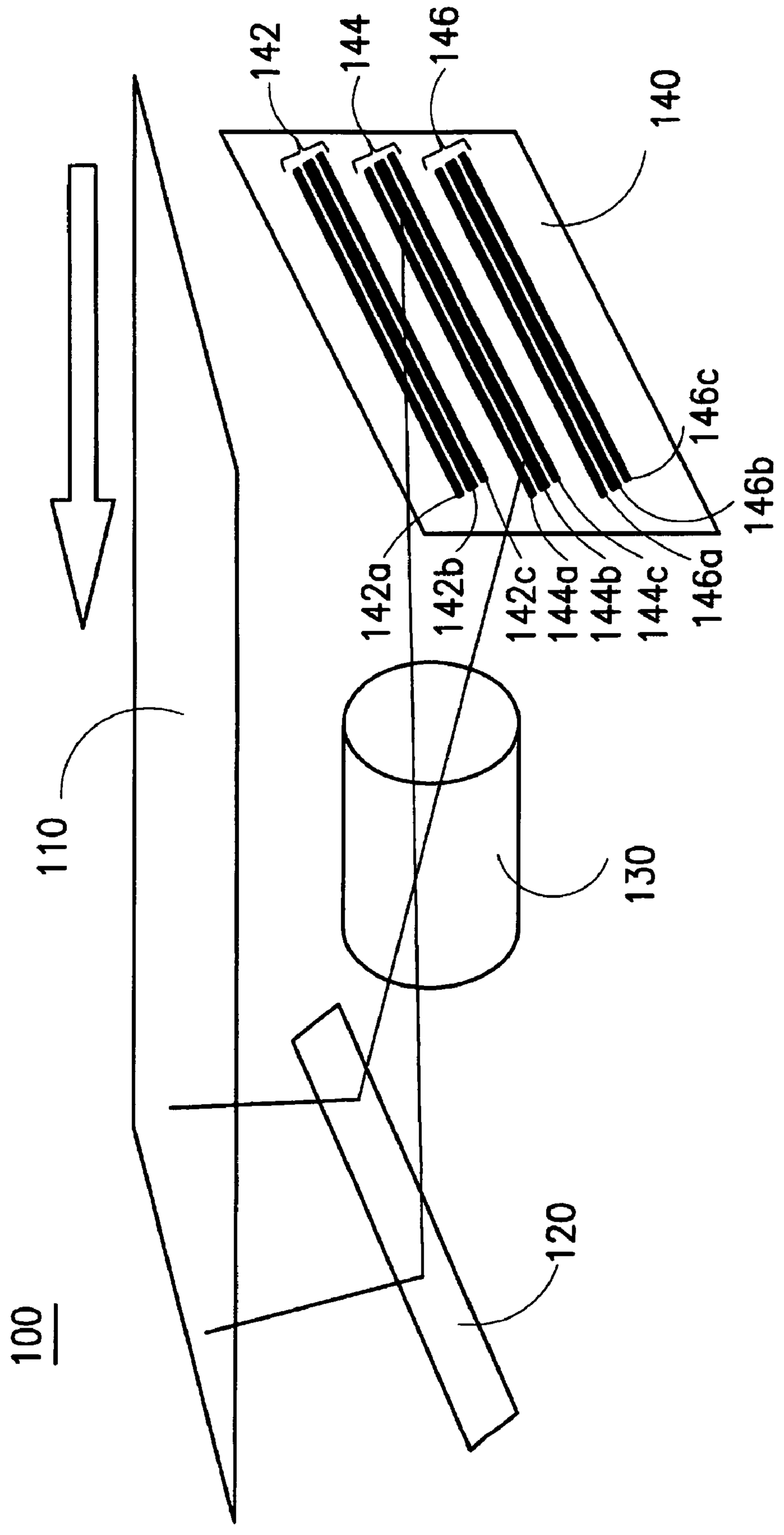

142
144
146
140
146c
146b
142a
142b
142c
144a
144b
144c
146a
110
130
120
100

FIG. 1

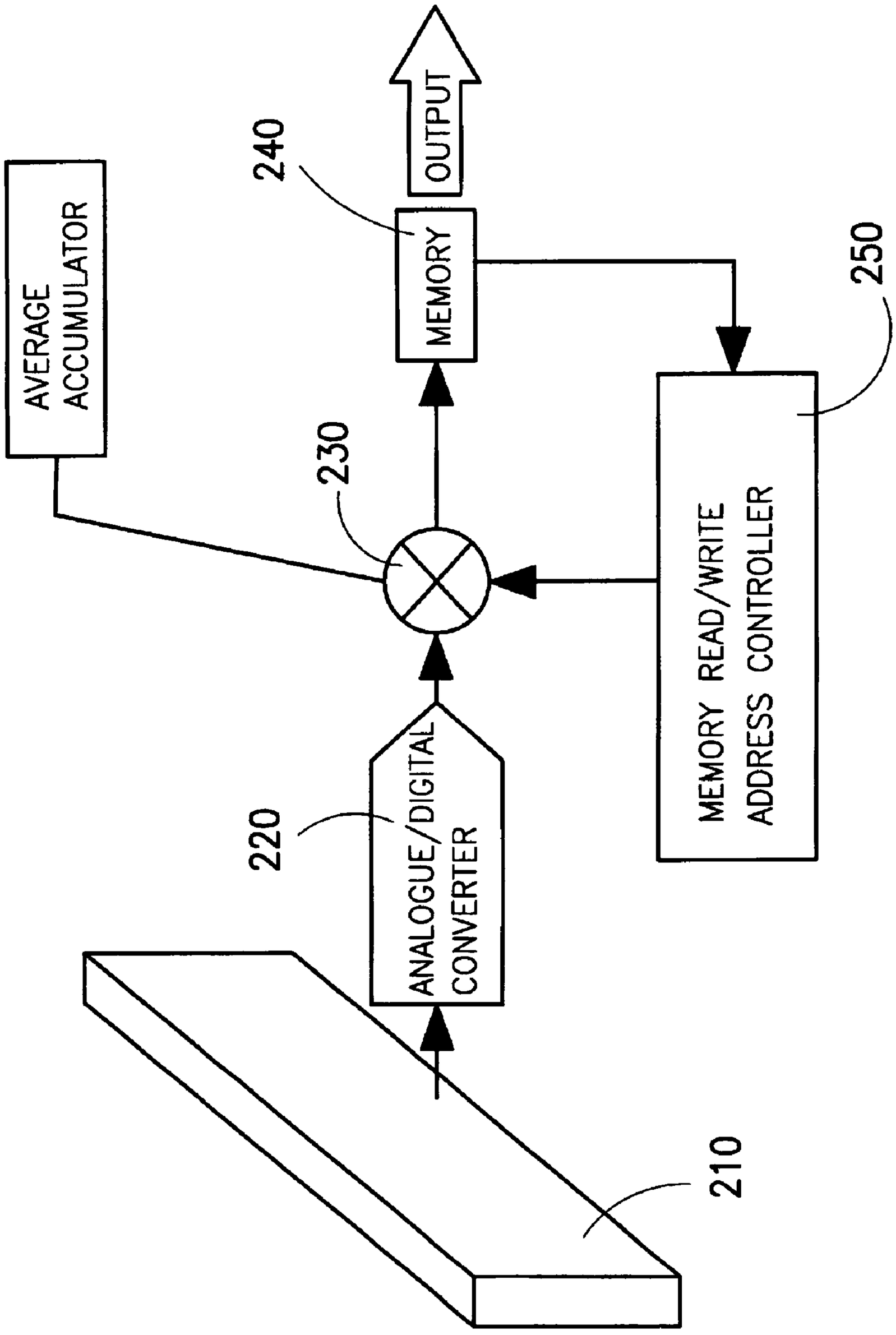

OUTPUT
240
MEMORY
250
MEMORY READ/WRITE ADDRESS CONTROLLER
230
AVERAGE ACCUMULATOR
220
ANALOGUE/DIGITAL CONVERTER
210

FIG. 2

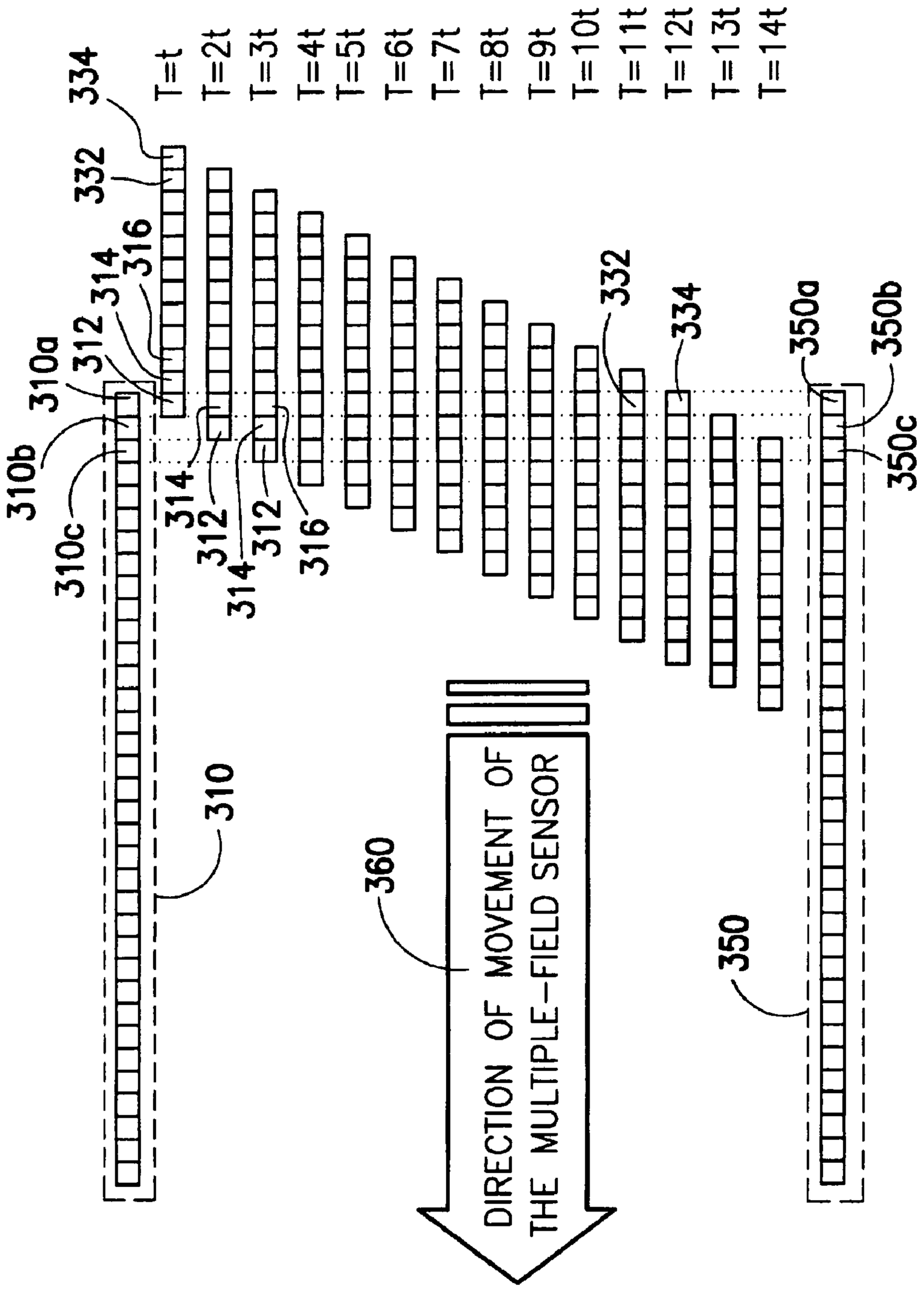

T=t
T=2t
T=3t
T=4t
T=5t
T=6t
T=7t
T=8t
T=9t
T=10t
T=11t
T=12t
T=13t
T=14t
334
332
316
314
312
310a
310b
310c
310
360
DIRECTION OF MOVEMENT OF THE MULTIPLE-FIELD SENSOR
350
350a
350b
350c

FIG. 3

MULTIPLE-FIELD SENSOR FOR SCANNING SYSTEM

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of Invention

The present invention relates to a scanner and a scanning method. More particularly, the present invention relates to a multiple-field sensor for image scanning.

2. Description of Related Art

Due to the rapid development of multimedia technologies, image processing speed and clarity have become an important consideration in the selection of a scanner by users. However, a scanner operates according to light reflected from a document. Hence, outside light or any irregular dispersion, diffraction may lead to certain degree of distortion for a scanned image. In addition, limitations in the manufacturing of sensors also contribute to the production noise signals that further distort the image.

An attempt to deal with image distortion problem has been proposed in the Taiwan Patent No. 385608. In the invention, a sensor is used to scan a document a multiple of times to obtain a multiple of scanned images. Thereafter, the scanned images are averaged to reduce the amount of distortion to the actual image. However, this and similar type of designs require multiple scanning and the sensor has to shuttle forward and backward many times. Hence, the scanning is time-consuming and highly inefficient.

In brief, common defects of conventional scanning techniques include:

1. The scanned image is likely to be distorted if noise signals contained within the image are untreated; and
2. If the scanned image is treated by scanning the same documents a few times using the same sensor, the sensor has to shuttle many times leading to time wastage and hardware control problems.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to a multiple-field sensor for a scanner suitable for scanning a document. The scanner includes a multiple-field sensor, an average accumulator, and a block of memory. The multiple-field sensor has a plurality of sensing lines for each color channel. Each sensing line picks up a portion of image signal from the document during scanning. The sensing lines scan the same portion of the document to produce corresponding image signals. The average accumulator averages the image signals obtained from the sensing lines of the same color channel to produce an average image signal. The block of memory is used as a storage area for image signals in general and the average image signal in particular. In addition, the scanner further includes a memory read/write address controller. The memory read/write address controller supplies addresses for storing and retrieving the image data and the average image data to and from the memory blocks.

The invention also provides a scanning method that utilizes a multiple-field sensor. The multiple-field sensor has a plurality of sensing lines corresponding to each color channel. Each sensing line can be used for scanning a document to obtain a corresponding portion of the image signal. First, the scanning lines sequentially scan an identical portion of the document to obtain a plurality of image signals. Thereafter, the image signals are averaged to obtain an average image signal. Finally, the average image signal is output. In addition, the step of obtaining an average image signal includes first storing the image signals and then adding up the image signals. Lastly, the sum is averaged to obtain the average image signal. Furthermore, the steps for obtaining an average image signal by the scanning method of this invention are executed in a pipeline mode.

In brief, a multiple-field sensor is used to obtain a multiple of image signals at the same time. The image signals are then accumulated and averaged in a pipeline mode of operation. Hence, image distortion due to noise interference is reduced without increasing scanning time.

It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings,

FIG. **1** is a schematic diagram showing a scanning system according to a first preferred embodiment of this invention;

FIG. **2** is a block diagram showing the internal circuitry of a scanner according to a second preferred embodiment of this invention; and

FIG. **3** is a schematic diagram showing the data generation sequence inside a scanner according to a third preferred embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

FIG. **1** is a schematic diagram showing a scanning system according to a first preferred embodiment of this invention. The scanner **100** includes a group of reflecting mirrors **120**, a group of lenses **130** and a multiple-field sensor **140**. Light reflected from a scan document **110** or light passing through a transparent document **110** is reflected by the reflecting mirror **120** and transmitted to the multiple-field sensor **140** after passing through the group of lenses **130**. The multiple-field sensor **140** has a plurality of sensing elements **142**, **144** and **146**. In this embodiment, each of the sensing elements **142**, **144** or **146** has three sensing lines. They are sensing lines **142**a, **142**b and **142**c for the sensing element **142**, sensing lines **144**a, **144**b and **144**c for the sensing element **144**, and sensing lines **146**a, **146**b and **146**c for the sensing element **146**. Although three sensing lines are shown in each sensing element, the actual number of sensing lines for each sensing element is a variable. Any scanner that employs a multiple-field sensor, **[**or in other words,**]** *such as* a scanner with multiple sensing line in a single color channel, can **[**use the invention to obtain the same effects**]** *be used*. For example, each of the sensing elements **142**, **144** and **146** may contain sensing lines to deal with the color channels RGB (such as

142a for the R channel, 142b for the G channel, 142c for the B. Alternatively, a multiple of sensing lines in each sensing element may deal with the same color channel (such as 142a~142c for the R channel, 144a~144c for the G channel, and 146a~146c for the B channel). [Obviously,] *It should be apparent that* a mono-color scanner can still use the system provided [by the invention] *in the present disclosure*.

In this embodiment, light emitted from an identical portion of the scan document **110** will be reflected by the reflecting mirror **120** and transmitted through the lenses **130**. Thereafter, according to the sequence arrangement of the sensing elements **142**, **144**, **146** and the forward-moving direction of the multiple-field sensor **140**, the light will shine onto the sensing elements **142**, **144** and **146**. In other words, the sensing elements **142**, **144** and **146** pick up light from the same portion of the scan document **110** and then the scanned image signals are accumulated and averaged. The accumulated average signals thus obtained serves as data for subsequent image processing.

FIG. **2** is a block diagram showing the internal circuitry of a scanner according to a second preferred embodiment of this invention. In the second embodiment, the scanner includes a multiple-field sensor **210**, an analogue/digital converter **230**, an average accumulator **230**, a block of memory **240** and a memory read/write address controller **250**. The average accumulator includes an adder and a divider that adds and averages incoming image data. The analogue signals received by the multiple-field sensor **210** represent image signals. The analogue signals are sent to the analogue/digital converter **220** and converted into digital image signals. The digital image signals are sent to the average accumulator **230** for further processing before transmitting to the memory **240** for storage. The average accumulator **230** operates on image data and data inside the memory **240**. When a portion of a scan document is scanned the first time, image signal obtained from the scanning is directly sent to the memory **240** for storage. When the same portion of the document is scanned by other sensing elements, the scanned image and the data stored inside the memory **240** are added together inside the average accumulator **230**. The resulting image data is again sent to the memory **240** for storage serving as the next image signal for the average accumulator **230**. When the last image signal that corresponds to the same portion of the scan document is transmitted from the multiple-field sensor **210** via the analogue/digital converter **220** into the average accumulator **230**, image data stored inside the memory **240** corresponding to the same portion of the document is also sent to the average accumulator **230**. The image signals are added together and then the combined image signal is sent to the divider to perform an averaging operation. Hence, an average image signal is obtained. The average image signal is sent to the memory **240** serving as data for subsequent image processing.

In the second embodiment, the memory read/write address controller **250** mainly serves as a memory administrator. The controller **250** provides the address of stored data to the average accumulator **230** and address for storing the results in the memory **240** after image data is added or averaged by the average accumulator **230**.

[Obviously, in signal processing,] *It should be apparent that* image signal generated by the sensing line for color channel R [can only accumulate] *is accumulated* with image signal generated by other sensing line of the same color channel R to form an average image signal. Image signal of other color channel such as color channel G and color channel B will be unaffected. Similarly, the treatment of other color channels (G and B) will not mixed with the color channel R.

FIG. **3** is a schematic diagram showing the data generation sequence inside a scanner according to a third preferred embodiment of this invention. As shown in FIG. **3**, at T=t, the sensing element **312** obtains a portion of an image signal **310**a from a scan document **310**. Thereafter, the multiple-field sensor moves in the arrow direction **360**. At T=2t and T=3t, the sensing element **314** and sensing element **316** each scans over a portion **310**a of the scan document **310** and hence each obtains a corresponding image signal. At the same time, the sensing element **312** scans over the portions **310**b and **310**c of the scan document **310** and obtains corresponding image signals.

At T=t, image signal obtained by sense element **312** through scanning the portion **310**a of the scan document is stored in the memory. At T=2t, the image signal obtained by sense element **312** through scanning the portion **310**a of the scan document is added to a previous image signal similarly obtained by the sense element **312** through scanning the identical portion **310**a. The result of the addition is stored in the memory. Such accumulation of image signal continues until time T=12t when the image signal obtained by sensing element **334** scanning over the portion **310**a of the scan document is also added to the accumulated sum. After the addition of the last image signal, the accumulated sum of the images signals are averaged by the average accumulator **230** shown in FIG. **2**. The averaged image signal (obtained at T=3t, for example) serves as data source for subsequent image processing.

Other portions of the scan document **310** such as **310**b and **310**c are similarly processed according to the aforementioned method, executing in a pipeline mode. Hence, after obtaining the first average image signal at T=13t, an average image signal is obtained at every interval of t. Although the averaging method can obtain a low noise level scan image, a processing time very close to a conventional scanner is required (the invention requires only an additional 13t to process).

In summary, the scanner in this invention is able to produce low noise level scan images in a very short time.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

What is claimed is:

1. A scanner [having multiple-field sensor] for scanning a document, *the scanner* comprising:

a multiple-field sensor having a plurality of sensing lines for each color channel, wherein each sensing line is [able] *configured* to obtain a corresponding image signal during scanning;

an average accumulator [for adding together and averaging] *configured to add together and average* image signals from all the sensing [line] *lines* that [corresponds] *correspond* to the scanning *of* an identical portion of the document, and [outputting] *output* an average image signal; and

a memory [for storing] *configured to store* the image signals obtained from the sensing lines and the average image signal.

2. The scanner of claim **1**, wherein the scanner further includes a memory read/write address controller [for controlling] *configured to control* memory accessing addresses.

3. The scanner of claim **1**, wherein the average accumulator further includes an adder and a divider, the adder [is used for accumulating] *configured to accumulate* image signals and the divider [is used for averaging] *configured to average* the sum of *the accumulated* image signals to produce [an] *the* average image signal.

4. An image scanning method that utilizes a multiple-field sensor having a plurality of sensing lines for each color chan-

nel and with each sensing line [capable of scanning] *configured to scan* a scan document, *the method* comprising [the steps of]:

sequentially scanning an identical portion of the scan document using the sensing lines to obtain a plurality of corresponding image signals;

averaging the image signals to produce an average image signal; and

outputting the *average* image signal.

5. The method of claim **4**, wherein [the step of] averaging the image signals [includes the substeps of] *further comprises*:

storing each image signal;

summing the image signals cumulatively; and

averaging the sum of the image signals to produce [an] *the* average image signal.

6. The method of claim **4**, wherein the averaging *of* the image signals is executed in a pipeline mode.

7. An image scanning method that utilizes a multiple-field sensor having a plurality of sensing lines for each color channel and with each sensing line [capable of scanning] *configured to scan* a scan document, *the method* comprising [the steps of]:

sequentially scanning an identical portion of the scan document using the sensing lines to obtain a plurality of corresponding image signals;

storing each image signal;

summing the image signals cumulatively; and

averaging the sum of the image signals to produce an average image signal.

8. A method, comprising:

scanning an image using a plurality of sensing lines to obtain a plurality of initial image signals that represent a same region of the image;

averaging the initial image signals to produce a final image signal; and

outputting the final image signal as a representation of the region;

wherein the initial image signals provide overlapping representation of the region.

9. The method of claim 8, wherein the image is scanned using a color scanner and the sensing lines correspond to a same single color channel.

10. The method of claim 8, wherein the image is scanned using a mono-color scanning device.

11. The method of claim 8, further comprising;

detecting at least one color channel; and

identifying the plurality of sensing lines used to scan the region of the image according to the detected color channel.

12. A method, comprising:

scanning an image using a plurality of sensing lines to obtain a plurality of initial image signals that represent a same region of the image;

storing the initial image signals;

averaging the initial image signals to produce a final image signal, wherein averaging the initial image signals to produce the final image signal includes:

summing the initial image signals; and

averaging the sum of the initial image signals to produce the final image signal; and

outputting the final image signal as a representation of the region.

13. The method of claim 12, wherein the initial image signals are summed cumulatively.

14. A system, comprising:

means for obtaining a plurality of initial image signals that provide overlapping representation of a region of a scanned document; and

means for averaging the initial image signals to produce a final image signal, the final image signal representing the region of the scanned document;

wherein the image signals correspond to an identical color channel for the region of the scanned document.

15. The system of claim 14, wherein the plurality of initial image signals are obtained concurrently and without requiring a scanner sensor to shuttle forward and backward multiple times.

16. The system of claim 14, wherein the image signals are mono-color.

17. An apparatus, comprising:

a first sensing line to generate an initial image signal by scanning a region of an image;

a second different sensing line to generate another initial image signal by scanning the same region of the image as the first sensing line; and

a processor configured to synthesize a final image signal for the region of the image using the initial image signals;

wherein the processor is further configured to synthesize the final image signal by averaging the initial image signals.

18. The apparatus of claim 17, wherein the first and second sensing lines are integrated in a same multi-field sensor.

19. The apparatus of claim 17, wherein the image signals are mono-color.

20. The apparatus of claim 17, wherein the sensing lines are arranged to generate the initial image signals concurrently and without requiring a scanner sensor to shuttle forward and backward multiple times.

21. The apparatus of claim 17, wherein the sensing lines are positioned to generate the initial image signals concurrently responsive to light reflecting from the image or from a mirror above the image.

22. The apparatus of claim 17, wherein the averaged image signal is a mathematical average of the initial image signals.

23. The apparatus of claim 22, wherein the mathematical average is obtained using an accumulator component and a divider component.

24. The method of claim 8, further comprising:

adding the initial image signals together; and

dividing a sum from the adding by a value equal to the quantity of the initial image signals, wherein the final image signal is a result of the dividing.

25. The method of claim 12, further comprising:

dividing the sum of the initial image signals by a value equal to the quantity of the initial image signals, wherein the final image signal is a result of the dividing.

26. The system of claim 14, further comprising:

means for adding the initial image signals together; and

means for dividing a sum from the adding by a value equal to the quantity of the initial image signals, wherein the final image signal is a result of the dividing.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

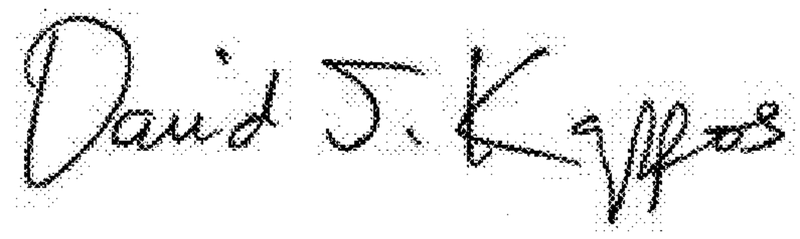
CERTIFICATE OF CORRECTION

PATENT NO. : RE42,618 E
APPLICATION NO. : 11/318393
DATED : August 16, 2011
INVENTOR(S) : Kuo

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5, line 47, in Claim 11, delete "*comprising;*" and insert -- *comprising:* --.

Signed and Sealed this
Fourteenth Day of February, 2012



David J. Kappos
Director of the United States Patent and Trademark Office