



US00RE43707C1

(12) **EX PARTE REEXAMINATION CERTIFICATE** (10088th)

United States Patent
Kimpe et al.

(10) **Number:** **US RE43,707 C1**
(45) **Certificate Issued:** **Mar. 31, 2014**

(54) **METHODS, APPARATUS, AND DEVICES FOR NOISE REDUCTION**

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Reexamination Request:

No. 90/020,037, Dec. 28, 2012

Reexamination Certificate for:

Patent No.: **Re. 43,707**
Issued: **Oct. 2, 2012**
Appl. No.: **13/338,880**
Filed: **Dec. 28, 2011**

Certificate of Correction issued Nov. 6, 2012

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **7,639,849**
Issued: **Dec. 29, 2009**
Appl. No.: **11/134,522**
Filed: **May 23, 2005**

Related U.S. Application Data

(60) Provisional application No. 60/681,429, filed on May 17, 2005.

(51) **Int. Cl.**
G06K 9/00 (2006.01)

(52) **U.S. Cl.**
USPC **382/128; 345/690**

(58) **Field of Classification Search**
None
See application file for complete search history.

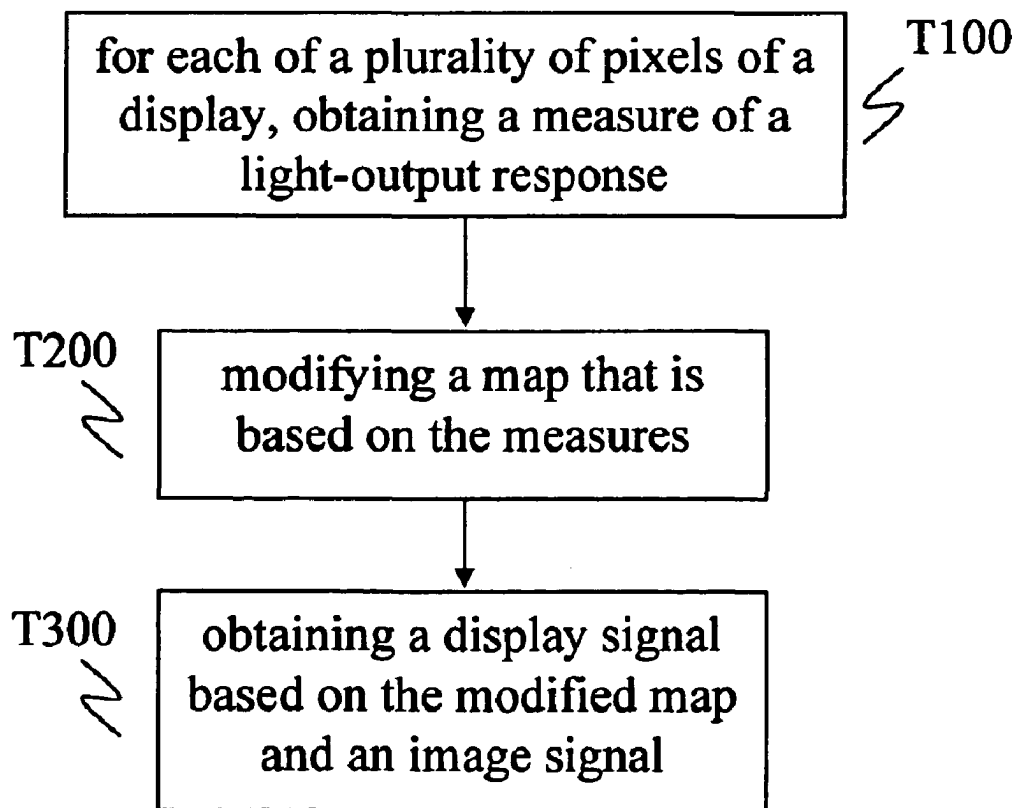
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/020,037, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Eron J Sorrell

(57) **ABSTRACT**

Embodiments include applying a compensation to an image signal based on nonuniformity of a display device. The compensation is based on information about variations in light-output response among elements of the display device. The compensation is also modified based on a characteristic of a desired use of the display.



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**EX PARTE
REEXAMINATION CERTIFICATE
ISSUED UNDER 35 U.S.C. 307**

THE PATENT IS HEREBY AMENDED AS
INDICATED BELOW.

Matter enclosed in heavy brackets [] appeared in the patent, but was deleted by the reissue patent; matter printed in italics was added by the reissue patent. Matter enclosed in heavy double brackets [[]] appeared in the reissue patent but is deleted by this reexamination certificate; matter printed in boldface is added by this reexamination certificate.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims 36, 46, 54 and 107 is confirmed. Claims 67, 77-79, 81, 82 and 92-94 are cancelled.

Claims 64-66, 68, 71, 74, 76, 80, 85, 91, 98, 100 and 101 are determined to be patentable as amended.

Claims 69, 70, 72, 73, 75, 86, 87, 88, 99, 102, 103 and 104, dependent on an amended claim, are determined to be patentable.

New claims 116-129 are added and determined to be patentable.

Claims 1-35, 37-45, 47-53, 55-63, 83, 84, 89, 90, 95-97, 105, 106 and 108-115 were not reexamined.

64. *The image processing apparatus of claim [[62]] 94, wherein the desired non-uniform light-output response comprises a lower degree of non-uniformity for pixels substantially at a center of the display than for pixels substantially at edges of the display.*

65. *The image processing apparatus of claim [[62]] 94, wherein the desired non-uniform light-output response comprises lower display noise for pixels substantially at a center of the display than for pixels substantially at edges of the display.*

66. *The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises a constant contrast for a majority of the display and a lower contrast near to edges of the display.*

68. *The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises, for pixels substantially at a center of the display, a lower degree of non-uniformity [[for driving levels]] among responses of the pixels to a value of the image signal that corresponds to a driving level in a first range of driving levels than [[for driving levels]] among responses of the pixels to a value of the image signal that corresponds to a driving level outside the first range of driving levels.*

71. *The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises:*

a first degree of non-uniformity [[at]] among responses of pixels of the display to a value of the image signal that corresponds to a driving level in a first range of driving levels; and

a second degree of non-uniformity [[at]] among responses of the pixels to a value of the image signal that corresponds to a driving level in a second range of driving levels.

74. *The image processing apparatus of claim 62, wherein*

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a first degree of non-uniformity [[for driving levels]] among responses of the pixels to a value of the image signal within a [[first range of driving levels]] luminance interval; and

5 *a second degree of non-uniformity [[for driving levels]] among responses of the pixels to a value of the image signal outside the [[first range of driving levels]] luminance interval.*

76. *The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises a contrast that is at least ninety percent of an uncorrected display contrast, and wherein said display is a liquid crystal display.*

80. *The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises a lower degree of non-uniformity within a first range of spatial frequencies than [[outside]] above the first range of spatial frequencies.*

85. *The image processing apparatus of claim 62, wherein the desired non-uniform light-output response is based in part on [[an effect of]] a spatial non-uniformity introduced by a post-processing system.*

91. *The image processing apparatus of claim [[62]] 80, wherein the map includes at least one lookup table.*

98. *An image processing apparatus comprising: an array of logic elements configured to generate a display signal based on a map and an image signal that represents at least one physical and tangible object, wherein the display signal is configured to cause a display to depict a display image of the at least one physical and tangible object,*

wherein the map comprises correction data configured to produce, for pixels substantially at a center of the display, a light-output response with a lower degree of non-uniformity [[for driving levels]] among responses of the pixels to a value of the image signal within a [[first range of driving levels]] luminance interval than [[for driving levels]] among responses of the pixels to a value of the image signal outside the [[first range of driving levels]] luminance interval.

100. *[[An image processing apparatus comprising: an array of logic elements configured to generate a display signal based on a map and an image signal that represents at least one physical and tangible object, wherein the display signal is configured to cause a display to depict a display image of the at least one physical and tangible object,*

wherein the map comprises correction data configured to correct for pixel non-uniformity only when the pixel non-uniformity is outside of a tolerance level]] The image processing apparatus according to claim 101, wherein the pixel non-uniformity is a color non-uniformity.

101. *[[The image processing apparatus of claim 100,]] An image processing apparatus comprising:*

an array of logic elements configured to generate a display signal based on a map and an image signal that represents at least one physical and tangible object,

wherein the display signal is configured to cause a display to depict a display image of the at least one physical and tangible object, and

wherein the map comprises correction data configured to correct for pixel non-uniformity only when the

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wherein the tolerance level varies among pixels of the display.

116. The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises a first degree of non-uniformity across a first range of driving levels, and

wherein the desired non-uniform light-output response comprises, across a second range of driving levels that is above the first range, a degree of non-uniformity that is higher than the first degree, and wherein said display is a liquid crystal display.

117. The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises a first degree of non-uniformity across a first range of driving levels, and

wherein the desired non-uniform light-output response comprises, across a second range of driving levels that is below the first range, a degree of non-uniformity that is higher than the first degree, and wherein said display is a liquid crystal display.

118. The image processing apparatus of claim 64, wherein the map includes a plurality of coefficients of a polynomial description.

119. The image processing apparatus of claim 64, wherein the map comprises correction data for a first pixel in the display based in part on a light-output response of at least one pixel in the display adjacent to the first pixel that has a degree of non-uniformity greater than a predetermined threshold.

120. The image processing apparatus of claim 64, wherein the map has a spatial resolution that is lower than a spatial resolution of the display.

121. The image processing apparatus of claim 91, wherein said correction data comprises a set of look-up tables, and

wherein a total number of look-up tables in the set is less than one percent of a total number of pixels in the display, and

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wherein each of said pixels to be corrected is associated with a corresponding one among the set of look-up tables.

122. The image processing apparatus of claim 64, wherein, for each of a plurality of pixels substantially at the center of the display, a maximum light-output response of the pixel after correction is intentionally greater than a maximum light-output response for pixels substantially at edges of the display, and

wherein, for each of said plurality of pixels substantially at the center of the display, said correction data indicates a corresponding correction value, wherein at least one of said corresponding correction values differs from at least one of the rest of said corresponding correction values.

123. The image processing apparatus of claim 68, wherein said display is a liquid crystal display.

124. The image processing apparatus of claim 69, wherein said display is a liquid crystal display.

125. The image processing apparatus of claim 70, wherein said display is a liquid crystal display.

126. The image processing apparatus of claim 81, wherein said display is a liquid crystal display.

127. The image processing apparatus of claim 82, wherein said display is a liquid crystal display.

128. The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises a constant maximum luminance for a majority of the display and a lower maximum luminance near to edges of the display.

129. The image processing apparatus of claim 62, wherein the desired non-uniform light-output response comprises a constant minimum luminance for a majority of the display and a higher minimum luminance near to edges of the display.

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