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(54) **Title:** VISUAL WEIGHT COMPENSATION

(57) **Abstract**: The invention relates to a method for determining a corrected weight of a mixed volume, e.g., of trash and cotton fiber. A total weight of the mixed volume is gravimetrically measured (102). An image of the mixed volume is created (104). At least one selected component within the image of the mixed volume is detected (106). A component weight of the at least one selected component is estimated (108) from the image of the mixed volume. The component weight is subtracted (110) from the total weight to yield the corrected weight.

Fig. 1

100
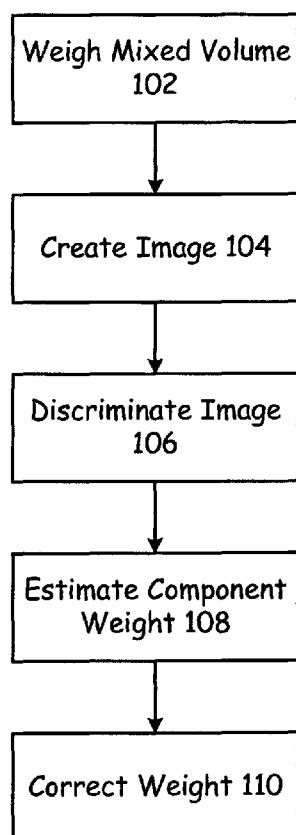
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

VISUAL WEIGHT COMPENSATION

FIELD

[0001] This invention relates to the field of fiber processing. More particularly, this invention relates to estimating the weight of disparate entities in a mixed volume, such as removing the weight of cotton fibers in a volume of trash.

INTRODUCTION

[0002] Many quality evaluations have as their basic component a determination of the amount of a contaminant that is found within an amount of the desired material. The fiber processing industry is no different. For example, cotton fibers can be graded based upon how much trash is included within a given volume of fiber. As the term is used herein, "trash" refers to any non-primary-fiber material, such as husks, twigs, leaves, dirt, rocks, and any other non-primary-fiber material that might become mixed into the fiber volume. In the case of cotton fibers for example, trash refers to anything that isn't cotton fiber.

[0003] Various methods have been devised to estimate or actually measure the amount of trash within a given mixed volume of fiber and trash. In some methods, the mixed volume is opened in some manner, and the trash is mechanically separated from the fiber. The amount of the trash that is removed from the mixed volume is weighed, and the weight of the trash is used as the basis of the quality evaluation, such as by comparing the weight of the trash to the weight of the mixed volume, or to the weight of separated fiber, or some other such comparison.

Unfortunately, it is relatively difficult to separate the fiber from the trash in a mixed volume. This difficulty results in the process either taking a longer time than desired, or producing an incomplete separation of the mixed volume – with either some amount of trash remaining in the fiber, or some amount of fiber remaining in the trash.

[0004] According to the publication EP-0'533'079 A2, the weight of the mixed volume is measured by weighing on scales. Then the mixed volume is mechanically separated into fiber and trash. The trash is optically sensed by an optical sensor. A computer receives the weight data from the scales and the output signal from the optical sensor. It calculates the

weight of the trash from the accumulated projected area of the trash. The fibers may be processed in the same way as the trash. This method also suffers from the drawback that the mechanical separation may be incomplete.

[0005] Some prior-art publications, such as CN-101'555'661 A, CN-201'255'721 Y and CN-201'269'857 Y, propose to determine the weight of trash within a mixed volume purely based on machine vision technique. An image of the mixed volume is taken and automatically processed. The trash weight is determined based on the measured trash area or volume and on an estimated mass density of the trash. Since the latter not precisely known, the results may not always be reliable.

[0006] What is needed, therefore, is a system by which problems such as those described above can be reduced, at least to some extent.

SUMMARY OF THE INVENTION

[0007] The above and other needs are met by a method for determining a corrected weight of a mixed volume, by gravimetrically measuring a total weight of the mixed volume, creating an image of the mixed volume, detecting at least one selected component within the image of the mixed volume, estimating a component weight of the at least one selected component from the image of the mixed volume, and subtracting the component weight from the total weight to yield the corrected weight.

[0008] In this manner, the weight of the mixed volume can be corrected by electronic means. This means that the mixed volume does not need to be painstakingly separated in some time-consuming or labor-consuming process. Nor does the weight of the mixed volume need to be compromised by the weight of components that are not supposed to be left within the mixed volume. Thus, a corrected weight that accurately represents the desired component or components of the mixed volume can be quickly, easily, and automatically generated.

[0009] In a preferred embodiment of the invention, the mixed volume comprises trash and cotton fiber, the at least one selected component is the cotton fiber, and the corrected weight is the trash weight. Thus, there is described a method for determining a trash weight of a mixed volume of trash and cotton fiber, by gravimetrically measuring a total weight of

the mixed volume, creating an image of the mixed volume, detecting the cotton fiber within the image of the mixed volume, estimating a cotton fiber weight from the image of the mixed volume, and subtracting the cotton fiber weight from the total weight to yield the trash weight within the mixed volume.

[0010] According to yet another aspect of the invention there is described an apparatus for determining a corrected weight of a mixed volume, with a gravimetric scale for measuring a total weight of the mixed volume, a sensor for creating an image of the mixed volume, and a processor adapted for detecting at least one selected component within the image of the mixed volume, estimating a component weight of the at least one selected component from the image of the mixed volume, and subtracting the component weight from the total weight to yield the corrected weight.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Further advantages of the invention are apparent by reference to the detailed description when considered in conjunction with the figures, which are not to scale so as to more clearly show the details, wherein like reference numbers indicate like elements throughout the several views, and wherein:

[0012] Fig. 1 is a flow-chart of a method according to an embodiment of the present invention.

[0013] Fig. 2 is a functional block diagram of an apparatus according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0014] With reference now to Fig. 1, there is depicted a flow-chart of a method 100 for correcting the weight of a mixed volume of material according to an embodiment of the present invention. The mixed volume is weighed, as given in block 102. This weight can be accomplished in a variety of different ways. For example, the mixed volume can be directly weighed with a gravimetric device like a scale, or weighed with a balance. Whatever method is used, this initial weight of the mixed volume is designated herein as the total weight.

[0015] An image is then created of the mixed volume, as given in block 104. In some embodiments, the mixed volume is scattered across a surface, such that all components of the mixed volume can be readily seen from one direction, such as from above the mixed volume. In this manner, the individual components of the mixed volume are not hidden, one by another, from the view-point of the imaging device. In some embodiments a single optical visible-light image from a single imaging device at a single location is used to create the image of the mixed volume. In other embodiments, multiple images from multiple sensors at multiple orientations are created, and in some embodiments wavelengths other than visible wavelengths are used to create the image or images. In still other embodiments, three-dimensional or quasi-three-dimensional imaging techniques such as tomography are applied. Other combinations of properties such as these are also contemplated.

[0016] Once the image has been obtained, as given in block 104, an algorithm is performed using the image as an input. The algorithm discriminates the various components of the image, as given in block 106. By "discriminates" it is meant that the various components of the mixed volume as depicted in the image are identified as to classification. For example, if the mixed volume is of fiber and trash, then those portions of the image that represent fiber are identified as one classification, and those portions of the image that represent trash are identified as another classification.

[0017] The algorithm can be adapted so as to identify more than two classes of components within the mixed volume, as desired. Various threshold levels can be set as desired so as to make the determination as to how a given portion of the image should be classified. Because in some embodiments the mixed volume does not completely cover the surface upon which is it disposed, the algorithm can be set, in those embodiments, to exclude from classification those portions of the surface that are visible in the image, as desired.

[0018] Once the image has been classified, as given in block 106, the weight of at least one of the classes of material within the mixed volume is estimated, such as by the algorithm. In some embodiments, the weights of all of the classes of material within the mixed volume are estimated, or the weights of some variable number of the classes are estimated.

[0019] For example, returning to the example of a mixed volume of fiber and trash, the weight of the fiber in the mixed volume can be estimated by the algorithm in one embodiment. This can be accomplished by, for example, determining the total volume of fiber within the mixed volume (from the image), and then multiplying that total volume by a presumed or measured fiber density value. A variety of different algorithms for determining the weight of the fiber (or the trash) could be used in different embodiments. These determined weights are designated as the component weights.

[0020] After the weight of at least one component of the mixed volume has been estimated, as given in block 108, the corrected weight of the volume is determined, as given in bock 110, such as by subtracting one or more of the component weights from the total weight. For example, in the fiber and trash example, the component weight of the fiber can be subtracted from the total weight, yielding a corrected weight of trash in the mixed volume. Alternately, the component weight of the trash can be subtracted from the total weight, yielding a corrected weight of fiber in the mixed volume.

[0021] It is appreciated that some of the steps of the embodiment of the method as described above do not need to be performed in the order as described above or depicted in Fig. 1. For example, measuring the total weight of the mixed volume, as represented in block 102, does not need to be accomplished prior to imaging the mixed volume and estimating the component weight or weights, as given in blocks 104-108. However, the steps of measuring the total weight and estimating at least one component weight do need to be accomplished prior to determining the corrected weight, as given in block 110. In some embodiments, these steps of measuring the total weight and estimating at least one component weight are accomplished substantially simultaneously.

[0022] With reference now to Fig. 2, there is depicted a functional block diagram of an apparatus 200 according to an embodiment of the present invention. A surface 218 receives the mixed volume 202. In the example as depicted, the mixed volume 202 is comprised of components 204, 206, and 208. For example, the mixed volume 202 might include trash 204, unknown object 206, and fiber 208. A scale 210 measures the total weight of the mixed volume 202, and provides the total weight to the processor 212 for further analysis. The sensor 214 records an image of the mixed volume 202 on the surface 218 within a field of view 216, and provides the image to the processor 212 for further analysis. The

processor 212 implements the algorithm as described above, and determines the corrected weight, as desired.

[0023] The foregoing description of embodiments for this invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiments are chosen and described in an effort to provide illustrations of the principles of the invention and its practical application, and to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

LIST OF REFERENCE SIGNS

100	Method 100 for correcting the weight of a mixed volume
102	Weighing the mixed volume
104	Creating an image
106	Discriminating the image
108	Estimating a component weight
110	Correcting the weight
200	Apparatus
202	Mixed volume
204	Trash
206	Unknown object
208	Fiber
210	Scale
212	Processor
214	Sensor
216	Field of view
218	Surface for receiving the mixed volume

CLAIMS

1. A method for determining a corrected weight of a mixed volume, the method comprising the steps of:

    gravimetrically measuring a total weight of the mixed volume,

    creating an image of the mixed volume,

5   detecting at least one selected component within the image of the mixed volume,

    estimating a component weight of the at least one selected component from the image of the mixed volume, and

    subtracting the component weight from the total weight to yield the corrected weight.

2. The method according to claim 1, wherein the mixed volume comprises trash and

10 cotton fiber, the at least one selected component is the cotton fiber, and the corrected weight is the trash weight.

3. An apparatus for determining a corrected weight of a mixed volume, the apparatus comprising:

    a gravimetric scale for measuring a total weight of the mixed volume,

15 a sensor for creating an image of the mixed volume, and

    a processor adapted for

        detecting at least one selected component within the image of the mixed volume,

        estimating a component weight of the at least one selected component from the image of the mixed volume, and

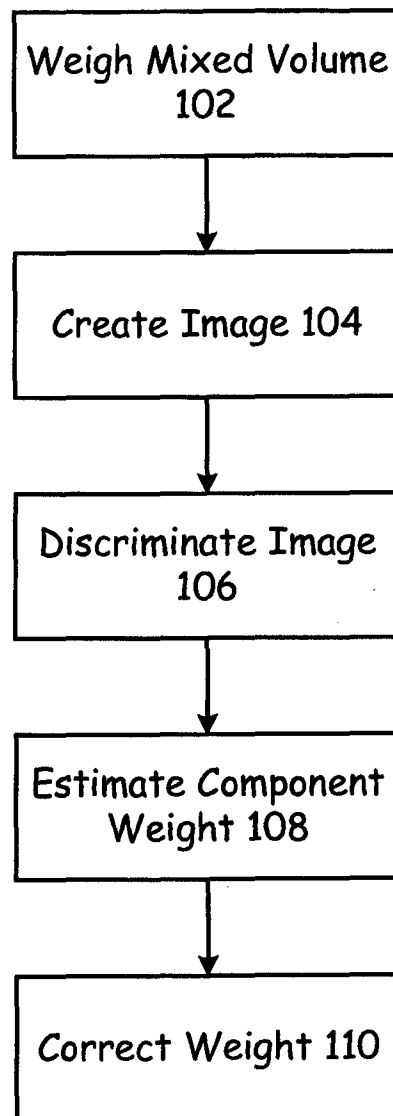20   subtracting the component weight from the total weight to yield the corrected weight.

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┌─────────────────────────┐
│   Weigh Mixed Volume    │
│          102            │
└─────────────────────────┘
              │
              ▼
┌─────────────────────────┐
│     Create Image 104    │
│                         │
└─────────────────────────┘
              │
              ▼
┌─────────────────────────┐
│   Discriminate Image    │
│          106            │
└─────────────────────────┘
              │
              ▼
┌─────────────────────────┐
│   Estimate Component    │
│       Weight 108        │
└─────────────────────────┘
              │
              ▼
┌─────────────────────────┐
│                         │
│   Correct Weight 110    │
│                         │
└─────────────────────────┘
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100

Fig. 1
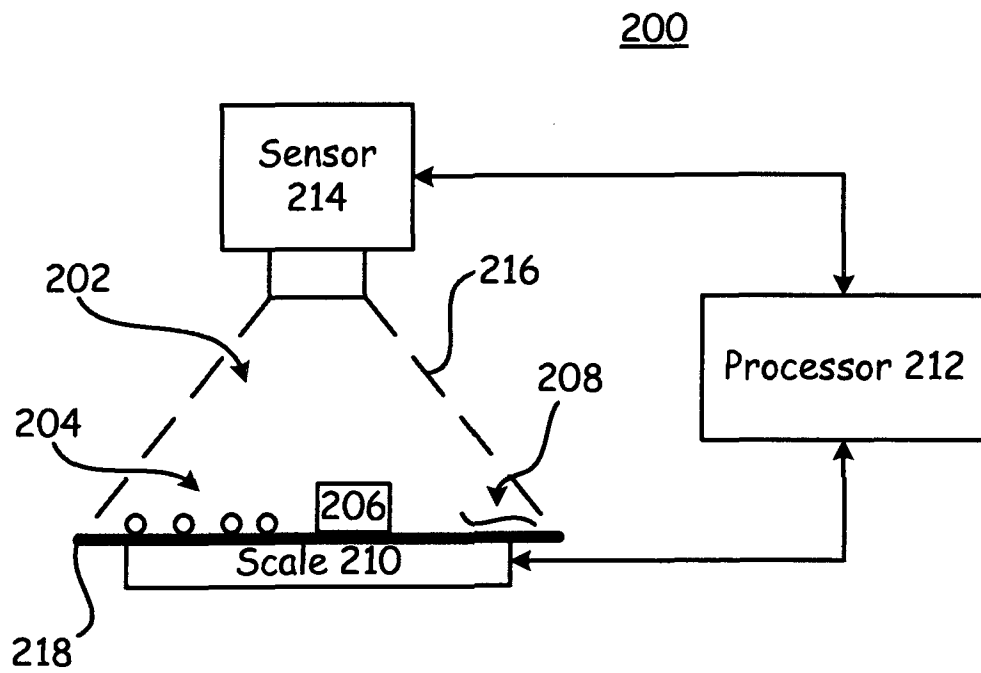
Fig. 2

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01N33/36   D01G31/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01N D01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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[X] Further documents are listed in the continuation of Box C.   [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 August 2011	10/08/2011

| Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016 | Authorized officer Joyce, David |

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

C(Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
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