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(54) Title: SCANNING APPARATUS AND METHOD

(57) Abstract: A scanning apparatus and method are disclosed in which an image linear sensor (2) CCD can perform a translation in a scanning direction (F) that is transverse to a direction of longitudinal extent of the sensor, with a first linear motor (31) coupled with a first end portion (21) of the sensor, with a second linear motor (32) coupled with a second end portion (22) of the sensor opposite the first, the motors being drivable independently to enable the two end portions to move at different speeds from one another, and with an alignment device that detects a misalignment of the linear sensor, consequently transmits a fault signal and drives the first linear motor and/or the second linear motor in response to the fault signal so as to realign the sensor by accelerating and/or decelerating the first and/or the second end portion of the sensor.

Scanning apparatus and method

Background of the invention

[0001] The invention relates to a scanning apparatus and method.

[0002] In particular, the invention refers to an apparatus and a method for correcting an alignment error of a movable scanning head with shuttle movements, i.e. linear movements backwards and forwards between two end positions.

[0003] Specifically, but not exclusively, the invention can be applied in a flatbed scanner for reading sheets, slides, etc, with automatic or manual feeding, in which the scanning head comprises a linear optical sensor, for example a sensor of CCD type.

[0004] Patent publication No. US 2003/137700 A1 discloses an apparatus according to the preamble of claim 1.

[0005] One of the problems of scanners of known type consists in that the scanning head can lose alignment, i.e. the preset orientation (normally perpendicular) with respect to the direction of the scanning movement. In general, in fact, a scanning head in a scanner of shuttle type is moved exactly perpendicularly to the direction of longitudinal extent of the linear optical sensor, thus the alignment error is nil and, accordingly, a possible cause of distortion of the image in the scanned data does not occur.

[0006] An alignment error is nevertheless possible that is such as to cause a distortion that is not acceptable with respect to the original image.

[0007] It is desirable to improve the prior art by making an image reading apparatus and/or method that is able to correct automatically and reliably in real time the alignment errors of a movable scanning head.

Summary of the invention

[0008] One object of the invention is to devise a scanning apparatus and/or method that are able to overcome the aforesaid problem.

[0009] One advantage is to provide a scanning apparatus and/or method that are able to correct automatically and reliably and in real time possible errors of alignment of the movable scanning head.

[0010] One advantage is to permit reading scanning of images with a reduced risk of an optical distortion with respect to the original image.

[0011] One advantage is to make available a constructionally simple and cheap

scanning apparatus.

[0012] One advantage is to permit safe and reliable operation of a scanning apparatus for reading images, with a relatively reduced risk of scanning errors and/or of jamming of the movement of the scanning head.

[0013] Such objects and advantages and still others are achieved by a scanning apparatus and/or method according to one or more of the claims below.

[0014] In one embodiment, a scanning apparatus comprises a linear image sensor that can perform a translation in a scanning direction that is transverse to a direction of longitudinal extent of the sensor, a first motor coupled with a first sensor portion, a second motor that is coupled with a second sensor portion and drivable independently of the first motor to enable the two sensor portions to be moved at different speeds from one another, and an alignment device that detects a misalignment of the linear sensor, consequently transmits a fault signal and drives the first motor and/or the second motor in response to the fault signal so as to realign the linear sensor by accelerating and/or decelerating the first sensor portion and/or the second sensor portion.

[0015] In one embodiment, a scanning method comprises the following steps: translating a linear image sensor in a scanning direction that is transverse to a direction of longitudinal extent of the sensor; coupling the linear sensor with two motors that are distinct and drivable independently of one another to enable two sensor portions to be moved at different speeds from one another; detecting a misalignment of the linear sensor and realigning the linear sensor by driving the first motor and/or the second motor so as to move at least one of the two sensor portions at a different speed from the other speed of the two sensor portions.

Brief description of the drawings

[0016] The invention can be better understood and implemented with reference to the enclosed drawings that illustrate an embodiment thereof by way of non-limiting example, in which:

Figure 1 is a schematic side view of an embodiment of a scanning apparatus made according to the present invention;

Figure 2 is a top view of Figure 1.

Detailed description

[0017] With reference to the aforesaid figures, a scanning apparatus that is usable for performing an optical reading of images has been indicated overall with 1.

[0018] The scanning apparatus 1 may comprise, in particular, a flatbed scanner for reading sheets, slides and the like, with a movable scanning head comprising a linear optical sensor. In Figure 1, with D an object has been indicated with a dotted line (for example a document in the shape of a sheet) that can be read (scanned) by the scanning apparatus 1.

[0019] The scanning apparatus 1 may comprise, in particular, at least one image linear sensor 2 extending in a longitudinal direction and able to perform a translation in a scanning direction F transverse (perpendicular) to the aforesaid longitudinal direction of the sensor.

[0020] The linear sensor 2 may comprise, for example, a sensor of CCD type. The CCD sensor may comprise, in particular, a series of photodiodes arranged on a linear matrix, suitable for performing a scan with three steps, one for each of the three RGB colours of the light. In other embodiments, the CCD sensor may comprise, in particular, a series of photodiodes arranged on three linear matrices on a chip, with the possibility of performing a reading scan in a sole step.

[0021] The linear sensor 2 may be configured to travel a scanning path with a shuttle movement (an outward and return stroke), with an outward and return rectilinear motion direction, between two end positions, i.e. a first rest end position (start and end of the scanning path) and a second stroke reverse end position (end of the outward stroke and start of the return stroke). The linear sensor 2 has to maintain a preset alignment, in the specific case the longitudinal extent of the matrix/matrices of photodiodes has to maintain a perpendicular orientation with respect to the direction of the scanning shuttle movement.

[0022] The linear sensor 2 may comprise, in particular, at least one first portion 21 and at least one second portion 22 spaced apart from the first portion 21 in the aforesaid longitudinal direction of the linear sensor 2. The two portions 21 and 22 may comprise, as in this specific embodiment, two end portions situated at the two opposite ends of the linear sensor 2.

[0023] The scanning apparatus 1 may comprise, in particular, at least one first motor 31 coupled with the first (end) portion 21.

[0024] The scanning apparatus 1 may comprise, in particular, at least one second motor 32 coupled with the second (end) portion 22.

[0025] The first motor 31 and the second motor 32 may be configured, in particular, to operate simultaneously in such a manner as to drive the translation of the linear sensor 1 in a two-way scanning direction F.

[0026] The first motor 31 and the second motor 32 may be drivable independently of one another to permit the first portion 21 and the second portion 22 to be moved independently of one another at different speeds from one another.

[0027] The first motor 31 may comprise, in particular, a linear motor, where linear motor is defined, in this description, as an electric motor in which the static part (stator) and the movable part (rotor) extend linearly. The linear motor may be configured, in particular, to produce a linear force rather than mechanical momentum. The second motor 32 may comprise, in particular, a linear motor.

[0028] The first motor 31 may be coupled with the first sensor portion 21 by, for example, fixing the movable part of the first motor 31 to the first sensor portion 21. The second motor 32 may be coupled with the second sensor portion 22 by, for example, fixing the movable part of the second motor 32 to the second sensor portion 22.

[0029] It is possible to provide, in other embodiments that are not illustrated, other types of drive motor and other types of connection between the linear sensor 2 and the two drive motors. Each motor could comprise, for example, a rotor (rotating shaft) and each rotor could be connected to a respective linear sensor portion 2 by a motion transmission mechanism, for example a mechanism with a rack and pinion and/or with a belt and pulley and/or with a chain and cog and/or with a connecting rod and crank and/or with screw and nut screw, etc.

[0030] The scanning apparatus 1 may comprise, in particular, guide means 6 with which the image linear sensor 2 is slidably coupled. The guide means 6 may comprise, in particular, at least two sliding guides, which are distinct from and parallel to one another, each of which is coupled with a respective portion 21 and 22 of the linear image sensor (as in these embodiments).

[0031] The scanning apparatus 1 may comprise, as in this embodiment, an alignment device configured to detect a misalignment of the linear sensor 2. The alignment device

may be configured, in particular, to emit a fault signal following the detection of the misalignment. The alignment device may be configured, in particular, to drive the first motor 31 and/or the second motor 32 in response to the aforesaid fault signal.

[0032] In this description, "misalignment" means the loss of the aforesaid (in general perpendicular) orientation with respect to the direction of the scanning movement of the linear sensor. A non-nil alignment error can cause undesired image distortion of the image in the scanned data.

[0033] The alignment device may comprise, in particular, corrected alignment reference means. Such reference means may comprise, for example, at least one reference line 4 that can be read by the linear sensor 2, for example during translation. The reading of the reference line 4 may be used to detect a misalignment of the linear sensor 2. The reference line 4 may comprise, for example, a (straight) colour transition line (for example white/black) arranged on the path travelled by the linear sensor 2 in the scanning movement thereof. The orientation of the reference line 4 represents the desired orientation of the linear sensor 2. The reference means may comprise, in other embodiments, in addition to or instead of the reference line 4, a different system for defining the correct alignment direction, like for example two or more reference points or notches that are readable by the linear sensor 2.

[0034] The reference line 4 may be arranged in the first rest end position or near the rest end position, or in the second stroke reverse end position or near the rest end position or any other zone of the scanning path comprised between the first and the second end position. It is also possible to provide two or more reference lines, for example arranged parallel to one another and spaced apart from one another.

[0035] The alignment device may comprise, in particular, control means 5 (electronic programmable, for example a computing unit or processor dedicated to performing computer programme instructions).

[0036] The control means 5 may be configured, in particular, to perform the operation of detecting a misalignment of the linear sensor 2, in particular during translation of the linear sensor.

[0037] In particular, the control means 5 may detect a misalignment whilst the first motor 31 and the second motor 32 move the first sensor portion 21 and the second sensor

portion 22 at the same speed.

[0038] The control means 5 may be configured, in particular, to perform the operation of controlling the first motor 31 and/or the second motor 32 (by a variation of the operating speed of at least one of the two motors 31 and 32) in response to the aforesaid fault signal, so as to accelerate and/or decelerate between the first sensor portion 21 and/or the second sensor portion 22.

[0039] In the attached figures, with 7 a case for containing and supporting the linear sensor 2, the two motors 31 and 32, the control means 5 and the guide means 6 has been indicated schematically. The case 7 may comprise, as in this embodiment, at least one (transparent) wall on which to position an object (document D) on which to scan and on which can be arranged the reference line 4.

[0040] The operation of the scanning apparatus 1 implements a scanning method that may comprise, in particular, the step of coupling a first motor 31 with a first portion 21 of one image linear sensor 2 and coupling a second motor 32 with a second portion 22 of the linear sensor 2, in which the two sensor portions 21 and 22 are spaced apart from one another in the direction of longitudinal extent of the linear sensor 2.

[0041] The scanning method may comprise, in particular, the step of translating the linear sensor 2 in a scanning direction F that is transverse to the longitudinal direction of the linear sensor 2 by simultaneous driving of both motors 31 and 32.

[0042] The scanning method may comprise, in particular, the step of detecting a misalignment of the linear sensor 2, for example by reading the reference line 4 and comparing the data received from the reading with stored data that define an alignment situation. If it emerges from this reading that the linear sensor 2 has a certain misalignment, the scanning method may comprise, in particular, the step of emitting accordingly a fault signal.

[0043] The aforesaid step of detecting a misalignment may comprise, as has been seen, the operation of reading the reference line 4 by the linear sensor 2 during translation of the sensor.

[0044] The scanning method may comprise, in particular, the step of realigning the linear sensor 2 in response to the aforesaid fault signal by a variation of a drive speed of the first motor 31 and/or of the second motor 32. If, for example, the alignment device has

detected a misalignment that is such that the first sensor portion 21 is retracted with respect to the second sensor portion 22, then the alignment device may control the first motor 31 (for example with an acceleration) to advance the first sensor portion 21 with respect to the second sensor portion 22, or the second motor 32 (for example with a deceleration) to retract the second sensor portion 22 with respect to the first sensor portion 21, until the alignment is re-established.

[0045] The aforesaid step of detecting a misalignment may be performed, in particular, during translation of the linear sensor 2.

[0046] In particular, the aforesaid step of detecting a misalignment may be performed whilst the first motor 31 and the second motor 32 simultaneously move the first sensor portion 21 and the second sensor portion 22 at speeds that are equal to one another.

[0047] The aforesaid step of realigning the linear sensor 2 may comprise, in particular, the operations of accelerating and/or decelerating the first sensor portion 21 and/or the second sensor portion 22.

CLAIMS

1. Scanning apparatus (1) comprising:

- at least one image linear sensor (2) extended in a longitudinal direction and configured to perform at least one translation in a scanning direction (F) that is transverse to said longitudinal direction, said at least one linear sensor (2) comprising at least one first sensor portion (21) and at least one second sensor portion (22) that is spaced from said first sensor portion (21) in said longitudinal direction;
- at least one first motor (31) coupled to said first sensor portion (21) and at least one second motor (32) coupled to said second sensor portion (22), said at least one first motor (31) and said at least one second motor (32) being configured to operate simultaneously in such a way as to actuate said translation of said linear sensor (2) in said scanning direction (F), said at least one first motor (31) and said at least one second motor (32) being operable independently of one another to allow movement of said first sensor portion (21) and said second sensor portion (22) with different speeds;

characterized by comprising:

- an alignment device (4; 5) configured to detect a misalignment of said linear sensor (2) thus emitting an anomaly signal and to actuate said at least one first motor (31) and/or said at least one second motor (32) in response to said anomaly signal.

2. Apparatus according to claim 1, wherein said at least one first motor (31) comprises a linear motor.

3. Apparatus according to claim 1 or 2, wherein said at least one second motor (32) comprises a linear motor.

4. Apparatus according to any one of the preceding claims, wherein said alignment device comprises control means (5) configured to control said at least one first motor (31) and said at least one second motor (32) in response to said anomaly signal in order to accelerate and/or decelerate said first sensor portion (21) and/or said second sensor portion (22).

5. Apparatus according to claim 4, wherein said control means (5) is configured to

detect a misalignment of said linear sensor (2) during said translation, in particular while said at least one first motor (31) and said at least one second motor (32) move said first sensor portion (21) and said second sensor portion (22) with equal speeds.

6. Apparatus according to any one of the preceding claims, wherein said alignment device comprises at least one reference line (4) which can be read by said linear sensor (2), particularly during said translation, the reading of said at least one reference line (4) being used to detect a misalignment of said linear sensor (2).

7. Scanning method comprising the steps of:

- coupling a first motor (31) to a first portion (21) of an image linear sensor (2);
- coupling a second motor (32) to a second portion (22) of said linear sensor (2) that is spaced from said first portion (21) in a longitudinal direction of said linear sensor (2);
- translating said linear sensor (2) in a scanning direction (F) that is transverse to said longitudinal direction by simultaneous actuation of said first motor (31) and second motor (32);
- detecting a misalignment of said linear sensor (2) and emitting an anomaly signal accordingly;
- realigning said linear sensor (2) in response to said anomaly signal by means of a variation of a driving speed of said at least one first motor (31) and/or of said at least one second motor (32).

8. Method according to claim 7, wherein said step of detecting a misalignment occurs during said translation.

9. Method according to claim 8, wherein said step of detecting a misalignment occurs while said first motor (31) and said second motor (32) move said first sensor portion (21) and said second sensor portion (22) with equal speeds.

10. Method according to any one of claims 7 to 9, wherein said step of realigning comprises accelerating and/or decelerating at least one of said first sensor portion (21) and said second sensor portion (22).

11. Method according to any one of claims 7 to 10, wherein said step of detecting a misalignment comprises reading at least one reference line (4) by said linear sensor (2) during said translation.

1/1

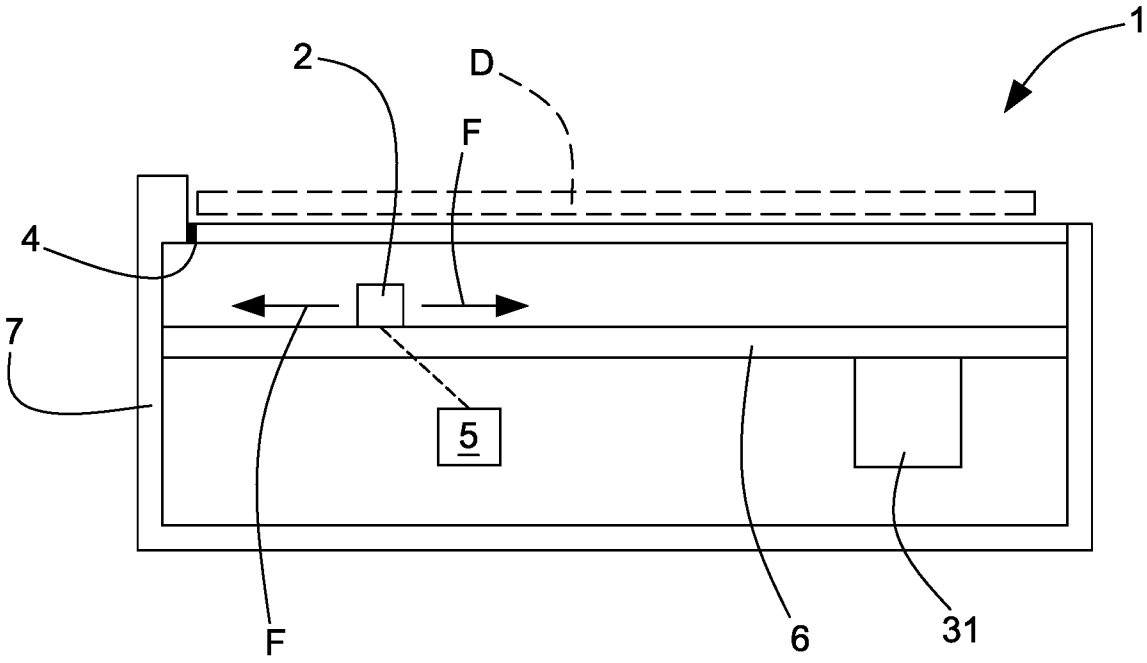

Fig. 1

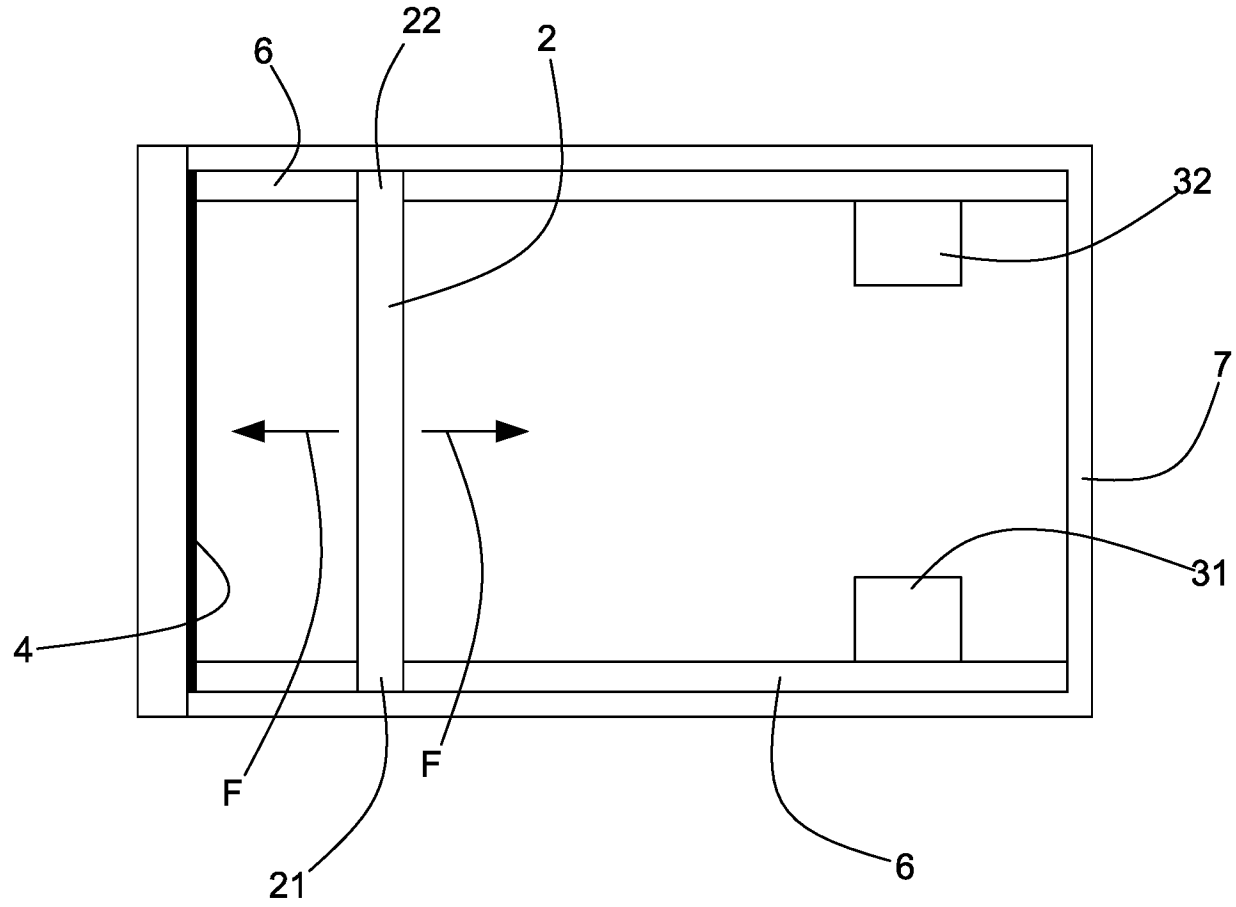

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/060985

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N1/047 H04N1/10
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)
H04N

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003/137700 A1 (KELSAY CURTIS GREGORY [US]) 24 July 2003 (2003-07-24) paragraph [0048]; figures 1,8 abstract	1-11
A	US 2002/003207 A1 (FANG PO-HUA [TW]) 10 January 2002 (2002-01-10) abstract; figure 4	1-11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2019/060985

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003137700 A1	24-07-2003	JP 2003228138 A	15-08-2003
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